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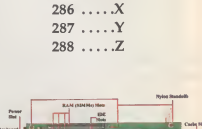

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Learning About Computers

How To Get The Most From This Dictionary

Programmers work with code, but the language they speak is laced with it, too. Just as doctors, lawyers, and military personnel all speak a jargon peculiar to their industry, so do the people who create computer hardware and software. Now that computers and digital technology have become such an important element of society at large, the non-engineers among us need to be able to speak the same language.

If you want a thorough yet concise introduction to the language of computing you've come to the right place. This fourth edition of our Computing Dictionary provides plain-English definitions to all the terms, abbreviations, and acronyms you're likely to encounter. Beyond definitions, however, this all-in-one reference work also provides complete primers on the companies, people, and technologies that occupy significant places in the computing industry.

Where To Begin. If you are new to computing and want to educate yourself about computers, read the "Industry Overview" and "PC Parts" sections. These sections will give you a basic understanding of how the computing industry developed, which components go into a modern PC, and how computers work.

Computing newcomers as well as long-time computer users will enjoy reading the sections called "Timeline" and "People & Companies." The articles there provide a wealth of information about particular events in the history of computing and the people who contributed to the development of various technologies. In the latter section you'll also learn more about today's most important and influential hardware and software companies.

For readers interested in connectivity and communications, the "Networking" and "Online" sections should prove invaluable. Articles in these sections cover significant networking and Internet technologies, especially the World Wide Web.

All these sections provide a general framework for understanding how technology developed and what the current state of the art is when it comes to personal computing. And then, of course, there are the terms.

Terms & Definitions. All terms in this dictionary are listed in alphabetical order. When abbreviations are given, they refer to spelled-out versions of the terms for definitions. Terms that begin with numerals appear at the very beginning of the "PC Terms" section.

There are many, many abbreviations used in computing. When those abbreviations are acronyms, we spell out pronunciations. When pronunciations are not given, that means an abbreviated term is spelled out letter-by-letter in common usage. We did not provide pronunciations for every term, under the assumption that using space for definitions was far more important.

In order to save space in our definitions, we have used the abbreviated forms of a limited number of terms. These terms appear so frequently that spelling them out in each definition would have required a significantly larger dictionary. We have tried to avoid making readers "bounce" from definition to definition in order to understand a single term, but unfortunately some additional referencing might be necessary.

Here is the list of the abbreviated terms you will find in definitions throughout this dictionary:

ASCII	CMOS	KB
BASIC	COBOL	MB
BBS	CPU	MHz
BIOS	DOS	PC
bps	dpi	RAM
CD	FORTRAN	ROM
CD-ROM	GB	VGA

If you are unfamiliar with these terms, you may find it useful to look them up prior to browsing through other definitions.

Abbreviated terms are presented in both uppercase and lowercase letters. Case is determined by prevailing usage. We've tried to indicate where alternative spellings are acceptable; for example, under "electronic mail" we indicate readers may see the abbreviated form E-mail spelled as e-mail or email.

Definitions are meant to be concise, yet complete enough to give some context for understanding both how and where the term is used. To help readers better understand some definitions, we occasionally refer to other terms. When the referral is stated "Compare to [term]," the term indicated is generally opposite in nature. When the referral is stated "See [term]," the term indicated is usually synonymous in nature.

As a general rule, we did not include people, companies, or specific software packages in our list of terms. We did include operating systems and environments, as well as software categories. We also did not refer to specific commands used on different systems, unless those commands are used in a more generic sense.

Finally: Space constraints limit the number of definitions we can place in print. Electronic publishing, however, has no such boundaries. For more definitions of computing terms, we suggest you visit our online dictionary at http://www.smartcomputing.com. ■

Silicon Dreams

The Past, Present & Future Of Computing In The Information Age

We live in interesting times. As the 20th century and the millennium draw to a close, the technology at our fingertips was hardly even dreamed of by people of just 20 years ago. Today's children represent an entire generation that can't remember a time without compact discs or cellular phones; they have had constant access to powerful personal computers since before they could walk. Yesteryear's industry rulers, people such as Henry Ford and John D. Rockefeller, have given way to a new breed of commercial emperors, fellows such as Michael Dell of Dell Computer Corp., and the richest person in the United States, Microsoft's Bill Gates. Internet startups and technology stocks are some of the hottest commodities on Wall Street, and information technology (IT) professionals are among the most sought-after personnel on the market today. Those of us who remember rotary telephones and IBM Selectric typewriters, however, know it wasn't always like this.

It hasn't really been so long since "snail" mail (postal mail) was the only kind of mail service and since a computer was an entire room full of wires and vacuum tubes. How did we come so far so fast? We owe our meteoric technological advances to many men and women; people of science and vision, who are driven either by the need to know or by the desire to build a better mousetrap. Thanks to these digital pioneers, we have in many ways shaken off the traces of the Industrial Age and been ushered into the Information Age.

■ A Long, Long Time Ago... Although the story of computing really begins clear back in ancient Egypt with the invention of the abacus, a calculator of sorts made of wood, wire, and beads, computing as we know it today began in England in 1822. Charles Babbage, a mathematician and inventor, began work on an early computing device, the Difference Engine, with his partner Joseph Clement. Work on the device ended 11 years later amid squabbles between Babbage and Clement. Babbage then began work on another, more sophisticated device known as the Analytical Engine. Although Babbage didn't finish either one of these devices, his conception of the Analytical Engine included plans to add an input device, a central processing unit, an output device, and memory. Considering that Alexander Graham Bell didn't get a patent for the telephone until 43 years after Babbage began work on the Analytical Engine, Babbage's ideas were definitely ahead of the times. His work in the field of computing earned him the unofficial "Father of Computing" title.

Vacuum tube geniuses. A century later, in 1942, the world was at war, and two men, John Mauchly and J. Presper Eckert, began work on a top-secret project for the United States military. The project, known as Project PX, was in fact the Electronic Numerical Integrator And Calculator (ENIAC), the world's first large-scale, general-purpose computer. The ENIAC was a monstrous amalgamation of 30 large units connected by wires—it very nearly took up an entire room. The computer performed calculations (nearly 5,000 additions and 300 multiplications per second) using nearly 18,000 vacuum tubes as digital on/off switches. Data input was through the use of IBM punch card readers, and IBM printers were the ENIAC's output devices. When

the ENIAC was completed in 1946, it was used to calculate trajectory for artillery gunners.

Vacuum tube computers continued to be prominent for many years, but vacuum tubes were somewhat problematic. They had an average life span of only about 20 hours, after which they would burn out. When a tube burned out in the ENIAC, for example, searching for the culprit through the computer's 18,000 tubes was a time-consuming process at best. Additionally, vacuum tubes created a great deal of heat when in use, and the heat from a great number of tubes caused some early computers to shut down every few minutes. This is why the development of the transistor in 1947 was a substantial step toward ushering in the second generation of computers, which began in the mid-1950s. In addition to running much more coolly and having longer effective life spans, transistors were faster than vacuum tubes and much smaller, which led to substantial space savings. Bell Labs introduced their first transistor computer in 1955, and more were soon to follow.

The integrated circuit and the microprocessor. Another substantial development in computing technology came in 1958 and 1959 when Fairchild Semiconductor and Texas Instruments simultaneously created and unveiled the integrated circuit. Integrated circuits allowed multiple transistors and other necessary components to be on one piece of semiconductor material, whether using germanium, the older material, or the newer, less expensive silicon. This eliminated the need for a great deal of wiring and allowed computers to become smaller still (although they were still considerably larger than those of today). Fairchild and Texas Instruments began to mass-produce integrated circuits in 1962. This created a whole new category of compact electronic devices such as calculators and hearing aids.

In addition to the advances in the physical construction of computers, other technological beginnings were taking place during the '60s. In 1969, for example, the US Department of Defense developed the Advanced Research Projects Agency NETwork (ARPANet). ARPANet was a computer network that allowed the sharing of data between government research facilities. It also was to provide communication in the

U.S. Army Photo

The ENIAC was the world's first large-scale, general-purpose computer.

event of wartime bombing or catastrophic natural disasters. In time, the ARPANet would become the Internet as we know it today.

In the 1970s, computer technology continued to advance, moving faster all the time. Random-access memory (RAM) was introduced, creating a space-effective medium for storing instructions soon to be used by computers. In 1971, Intel developed the first microprocessor, the Intel 4004. Microprocessors are small, self-contained electronic circuits with large numbers of transistors (for digital calculation) connected by tiny wires that carry information at extremely high speeds. The arrival of microprocessors heralded the age of microcomputers, computers that could do the work of the giant, room-filling computers of the 1950s and 1960s while occupying a fraction of the physical space.

The personal computer is born. By 1974, the existence of microprocessors and RAM allowed for such an economy of space in computer design that a few companies began to design and market personal computers. Micro Instrumentation and Telemetry Systems (MITS) released one of the very first desktop PCs, the Altair 8800. Altair's personal microcomputer cost $397 (with some assembly required) and came with a whopping one kilobyte (KB) of memory.

The next year, 1975, MITS shipped its Altair mail-order computer kits with a custom-made version of a computer language program called Beginner's All-Purpose Symbolic Instruction Code (BASIC). BASIC was first created in the mid 1960s at Dartmouth College by John Kemeny and Thomas Kurtz. However, Paul Allen, an engineer from Boston, and William Henry Gates III, a Harvard student, developed this new version. The two wrote their own derivative of BASIC for use with the Altair. After that, Gates dropped out of school and joined Allen in forming a partnership called Micro-soft (they later dropped the hyphen, leaving the name as Microsoft). The combination of the Altair's design and Micro-soft's BASIC helped to sell approximately 10,000 8800s, making it the first commercially successful microcomputer.

The very next year, Steve Wozniak and Steve Jobs founded Apple Computer after building the first Apple in the garage of Steve Job's parents' home. In 1976, Apple introduced the Apple II, the first personal computer to feature color graphics. Also, Commodore announced its Personal Electronic Transactor (PET) and Radio Shack launched its TRS-80 line of microcomputers. Texas Instruments also threw its hat into the microcomputer ring in 1979 with the TI 99/4. In 1980, IBM drew up plans to release its own personal computer. The PC wars had begun, although almost nobody knew it.

The rise of the "Wintel Monopoly." By this time, IBM was making considerable money selling large, powerful mainframe computers to government agencies and businesses. The company didn't really consider PCs anything more than a curiosity or a fad—a specialty item for engineers and geeks at best. However, the company didn't want to be behind if there was a market for PCs. So, to keep their development costs as low as possible, they hired Paul Allen and Bill Gates to develop an operating system (OS) for the company's computers. In a move that would change the futures of both IBM and Microsoft forever, they allowed the duo to retain marketing rights for the Disk Operating System (DOS, pronounced "doss") software. It took IBM's PC (released in 1981) to the top of the PC heap in a hurry, and along the way it became the most popular OS. Because Microsoft retained the marketing rights to DOS, the company was able to sell licenses for its use to other computer manufacturers, as well. Thus, the Microsoft empire was born.

Meanwhile, Intel and other chip manufacturers continued to create faster, smaller microprocessors that computer makers used to take mainframes and desktop computers alike to new heights of computing power. The popularity of personal computers continued to rise, and in 1983 the PC was *Time* magazine's "Man of the Year." By 1995, personal computers had become a staple of modern life. Offices, schools, and homes all over the world were using IBM PCs and PC clones manufactured by a host of companies (worldwide shipments of PCs in 1995 alone totaled nearly 57 million). The majority of PCs from the mid-to-late 1980s and on through the 1990s had Intel microprocessors and ran Microsoft's popular Windows family of OSes. The proliferation of these machines gave rise to the term "Wintel Monopoly" (Windows + Intel).

■ Teetering On The Brink Of A Millennium.

You don't have to look very far today to see the effect of technology and computers on modern society. Microprocessors are present in a considerable portion of the devices we use at work and at play. Everything from cellular and digital phones to automobiles and air conditioning units depend on computer chips to operate automatically and more efficiently (most of

Courtesy of Information Business Machines Corporation. Unauthorized use not permitted.

IBM's S/390 has many times the computing power of early mainframes such as the ENIAC. It fits into a case about the size of a refrigerator.

the time). Computers allow meteorologists to keep an eye on the weather and they help air traffic controllers keep track of amazing numbers of planes simultaneously. Perhaps the most profound effect of computers on modern society, however, can be seen in the vast numbers of people who use computers every day to increase their productivity. From multimillion-dollar supercomputers used for high-tech corporate research to tiny, handheld devices that people use to keep track of personal information, computers help members of modern society do more in an average day than could reasonably be accomplished in a week 20 years ago.

The top of the digital foodchain. At the top of today's computer hierarchy are supercomputers and mainframes. Supercomputers are highly expensive, ultra-sophisticated machines capable of calculating immense amounts of data in very short time periods. Corporations generally use them for research such as engineering and design, vehicle crash simulations, and intricate theoretical modeling.

Although today's mainframes share their name and their basic job description (a large, complex computer that supports use by many people at once) with the mainframes of yesteryear, that is about as far as the comparison goes. Today's portable notebook PCs have greater computational abilities than the first- and second-generation mainframe computers. Plus, the mainframes of today offer the same amount of power to hundreds and even thousands of users simultaneously while taking up a fraction of the space occupied by early monsters such as the ENIAC. IBM's S/390 mainframes, for example, come with multiple high-tech processors and gigabytes (GB, approximately one billion bytes) of memory as opposed to the megabytes (MB, approximately one million bytes) that PCs have. All this technology is packed into a cabinet about the size of a refrigerator. Mainframes of this type handle a variety of tasks, including serving shared files to computers on an internal network or over the Internet and/or processing and storing vast amounts of critical data.

Below mainframes and supercomputers are minicomputers, servers, and workstations. Simply put, minicomputers are scaled-down mainframes that handle applications and data processing for anywhere from four to 200 users. Servers are computers dedicated to the specific task of making shared data available to many computers on a network, whether it be a company intranet or a Web server giving access to computers around the world. The main distinction between servers and mainframes or minicomputers is mainframes actually perform processing duties and run multiple applications for a large number of users via computer terminals, while servers make data available to networked machines, but leave the running of applications and data processing to users' computers. Workstations are a step above PCs in terms of power and technology. People use them for graphic design, computer-aided design (CAD), high-end desktop publishing, and other specific applications that require a bit more muscle than your average desktop PC.

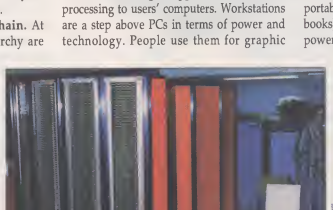


Photo courtesy of Michael John Nosso

Supercomputers are capable of processing enormous amounts of data. The Cray XMP48 is an early example of a supercomputer.

Computers for everyone else. For those of us who don't need a supercomputer, there are many options available. Today's desktop PCs are very powerful in their own right. They make everything from doing your taxes to creating a church newsletter easier. When you consider the fact that the navigational guidance computer onboard the Apollo 13 spacecraft had 36 kilobytes (KB, one thousand bytes) of memory, today's PCs containing 64MB and 128MB of RAM are impressive. People use PCs today for a wide range of activities, including personal and business accounting, desktop publishing, Internet access and communicating through E-mail, and entertainment.

For mobile professionals in today's workforce and for others who are often on the go, the traditional model of a desktop PC, (consisting of a central processing unit (CPU), a monitor, a keyboard and mouse, and a printer), has become impractical. For such people, the ideal computer is one that can travel outside the office, home, or even around the world. This is why PC makers offer a wide range of computing options that don't tie users to a single desk or office building. Portable PCs, which first began to surface in the early 1980s, are now a staple among traveling marketing professionals, executives, students, and other "on-the-go" computer users. As is the case with mainframes and PCs, portable computers (often referred to as notebooks) have become much smaller and more powerful. The first commercially successful portable computer, the Osborne I, came out in 1981 and weighed 25 pounds. For $1,795, you got a flip-down keyboard lid, a 5-inch display, two 5.25-inch diskette drives, and 64KB of memory. By way of comparison, for $4 more (as of this writing) you can get a computer such as Compaq's Presario 1600. This system features a 380MHz AMD K6-2 processor, 32MB RAM, a 4.8GB hard drive, 32X CD-ROM drive, and a 3.5-inch diskette drive. Oh yeah, and it weighs less than 8 pounds.

There is even a sub-category of notebooks, called mininotebooks, that weigh less than 4 pounds and offer most of the functionality that their bulkier cousins provide. Notebook PCs are great for giving presentations, generating reports, on-the-spot revisions to documents, and keeping in touch with others via E-mail while away from the office.

PDAs. Another segment of portable computing devices that has gained vast popularity in the last two to three years is that of personal digital assistants (PDAs). PDAs started as tiny electronic devices, resembling calculators, used to keep track of contact data, such as names, telephone numbers, and addresses, and scheduling information. Although they are still very handy at keeping such information organized, they have evolved into much more than electronic Rolodexes. The two most prominent types of PDAs are handheld PCs (HPCs) and palm-size PCs. HPCs have scaled-down keyboards, color touchscreen displays, small but adequate supplies of internal memory, and the ability to share information with desktop and notebook PCs. Many HPCs even

InfoGear's iPhone is a full-featured telephone that also offers voice mail, E-mail, and Internet access in one tidy package.

use a scaled-down version of Microsoft's Windows OS, Windows CE, which also offers users a point-and-click graphical user interface (GUI) similar to what they get with standard Windows versions. In addition to traditional PDA features and functions, HPCs generally come with internal or attachable modems that allow them to access the Internet.

While many HPCs have grown too large for practical handheld use, palm-size PCs still live up to the name, offering input via touchscreen and a few simple navigation buttons rather than a keyboard. Palm-size PCs such as 3Com's Palm IIIx can do most anything that HPCs can do, including linking to standard PCs for data storage and synchronization and, in many cases, accessing the Internet. PDAs offer a very handy mobile document solution, as many have the ability to fax or send documents to a standard printer. While extensive data or text input may not be extremely comfortable on some PDAs, many users find this to be an acceptable tradeoff for their light weight and the small amount of space they occupy.

Miscellaneous Internet access devices. Many people today buy computers and related devices solely for the ability to access what may be the single most important technological phenomenon of the last decade or two: the Internet. Computer and electronics manufacturers have rightly deduced that people may be just as willing to purchase a less-expensive Internet device that takes up less space. Although it has not taken off as its creators and investors hoped it would, WebTV is a prime example of such devices. WebTV units now cost less than $100 in most cases, and they allow users to browse the Internet and the Web on their TV screens.

Another emerging Internet device category is the smart phone, a telephone with a display that allows for quick, convenient Web browsing. A great example of a smart phone is InfoGear's iPhone. The iPhone is a telephone, answering/voice mail machine, and Internet browsing device that sells for about $399. Some mobile cellular and digital phone service providers are getting in on the action as well; they are offering mobile phones that have displays large enough to browse Web pages and compose or read E-mail messages. Such devices are likely only the tip of the iceberg. International Data Corp. (IDC) recently predicted that by 2002, PDAs and other non-desktop computing devices will account for 50% of all Web-enabled devices.

Smart cards. One exciting new facet of technology that is currently in its infancy in terms of consumer awareness is smart cards. Smart cards are credit-card sized cards that contain microchips that store data for use with computers. For example, your smart card might have security codes for accessing sensitive files stored on your computer at work or at home. It might also have your complete medical record stored on it, including past medical procedures, medications, and allergic reactions. Your smart card might even have electronic cash stored on it so you can use it in lieu of a traditional credit card to make purchases or transfer funds.

Computers can read smart cards through a variety of means. ATMs in Europe and selected areas of the United States have the ability to read the imbedded microchips on smart cards. This is only the beginning of the smart card world according to smart card proponents. These people envision a world where every kind of business has a smart card-compatible computer. Right now, any PC using special readers that connect via USB, serial, or parallel ports can read smart cards. One company, SmartDisk, developed Smarty, a smart card reader that fits into any PC's 3.5-inch diskette drive. One of the advantages that smart cards have over current credit or debit cards is that the cards actually communicate with the computer that is reading it. In addition, the cards can store transactions so businesses can make apt recommendations for each consumer electronically. This also means that you can easily track promotional programs such as frequent flyer miles or sandwich club points all on one card you carry with you everywhere you go.

Changing roles. A look at the history and evolution of computing technology very quickly gives one the impression that the only true constant is that computers change. A quick look around at how computers are being used today bears this idea out. The biggest change besides the rampant onslaught of new technologies is the growing perception that if two heads are better than one, two or more computers must likewise be better than one. The traditional standalone PC is rapidly going the way of the dinosaur; it is being replaced by PCs connected in various ways to form a world of computer networks. Computer networks certainly aren't a new concept (remember ARPANet?), but the practice of sharing computer resources via networks is becoming the rule rather than the exception. Fortune 500 companies, tiny two- and three-computer offices, and schools are all reaping benefits from connecting their PCs, workstations, and mainframes to offer employees and students the benefits of real-time collaboration and easily accessible data.

All these intranets (small, local-area networks within companies, schools, and homes) are likewise becoming connected to the world network, the Internet. We have mentioned on more than one occasion already how important a factor Internet access can be for those considering the purchase of computing devices, but we cannot stress this fact enough when discussing the role of computers in modern society. The Internet, which started as a Defense Department project and at some point became a new frontier in research for computer and software engineers and a hobby for technology enthusiasts, has become the newest form of mass media. As more people flock to Internet service providers (ISPs) to get online, companies of all kinds are becoming aware of the vast commercial potential of the Internet. The money these companies are putting into the Internet, coupled with the growing interest of the world's citizens is creating an amazing new online culture. People use the Internet to buy and sell goods, to gather information and exchange ideas, to communicate, and just to

have fun. The 24-hour availability of the Web combined with the immediacy of its content and the amazing handiness of E-mail is making the Internet and computer networks a way of life. *(NOTE: For more information on how the Internet and the World Wide Web work, see the "Online" section of this issue.)*

■ **Brave New World.** The amazing advances in computer technology over the last several years lead one to wonder what might be coming next. Science fiction novels and movies have long included predictions of what computers will be like and how we will use them in the 21st century and beyond. A typical scene during an episode of "Star Trek: The Next Generation" went something like this:

"Computer," the intrepid Captain Jean-Luc Picard begins, "What is the current location of First Lieutenant Cannonfodder?"

The nearly omniscient computer of the Enterprise chirps softly to acknowledge his question. Shortly thereafter, it replies, "First Lieutenant Cannonfodder beamed down to the planet surface four minutes and 59 seconds ago. His life signs are no longer detectable."

Of course, science fiction doesn't always translate into real-world technology, but some of what the computer did in the above scene are technologically feasible in the 20th century. While we can't "beam" ourselves places yet, computers that can understand spoken language are on their way. Even computer devices that recognize who and where a person is are coming sooner than you might think.

3Com's Palm IIIx is one of the hottest palm-size PCs on the market today.

Oxygen. At a recent celebration of the 35th anniversary of the Massachusetts Institute of Technology's (MIT) Laboratory of Computer Science (LCS), several researchers gave presentations on an amazing computing project named Oxygen. Oxygen is based on the idea that in the future, computers and computing will be free and everywhere you go, just like the air we breathe. The project revolves around three main components: the Handy21, the Enviro21, and the N21 network. The Handy21 will be a portable device that somewhat resembles a cellular phone and contains a display, communications equipment, global positioning satellite (GPS) devices, and other high-tech components. Everyone will carry a Handy21 with them instead of a phone, a pager, a notebook PC or PDA, a radio, and a variety of other electronic devices because—this is the cool part—the device will have the ability to reconfigure itself at your command to do any of these jobs at a moment's notice. Explaining how it will do this requires a lot of fairly technical computer theory, but, in a nutshell, Oxygen will be based on microprocessors that can actually "rewire" themselves within seconds. Sound a little like an episode of "Star Trek?" It gets better.

SmartDisk's Smarty smart card reader fits into any PC's 3.5-inch diskette drive.

The Handy 21 will work in conjunction with Enviro21 devices, computers in the walls of your house and office and in your car. The Enviro21 will be able to communicate with the Handy21 units of anyone within a certain range, and will in turn be connected to other Enviro21s via the world's N21 network.

The applications for such devices are unlimited. For example, say you are on vacation in Mexico when an incredible idea for increasing productivity at your company's factory hits you. You pull out your Handy21 and tell it to contact Bob in Production. Your Handy21 communicates your request to the Enviro21 in your rental car, which connects with the Enviro21 in Bob's office in Lincoln, Neb. via the global N21 network. If Bob is in his office, his Enviro21 informs him you are calling. If he is not there, it contacts his Handy21 (because it knows where the Handy21 is, thanks to the N21 network) and patches you through automatically with voice and video connections. Unless, of course, he has instructed his Handy21 to not accept calls while at he is at his favorite restaurant or unless his home Enviro21 knows Bob is sleeping and doesn't want to be disturbed. The team at LCS envision Oxygen as a way for people to do much more with much less effort by making the technology work intelligently for its users.

If Oxygen sounds like pie in the sky stuff, think again. The crew at MIT's LCS are on the case. Many of the computing technology breakthroughs we take for granted were developed by researchers at the LCS or by former LCS members.

More science fiction made real. Other coming attractions of computing technology include smart card-like devices that will transmit information to another person's card through simple contact using the body's own electrical transmissions (imagine exchanging business cards or pesto recipes with a handshake) and computers that deliver information through three-dimensional (3-D) projections controlled by simple hand motions or body postures.

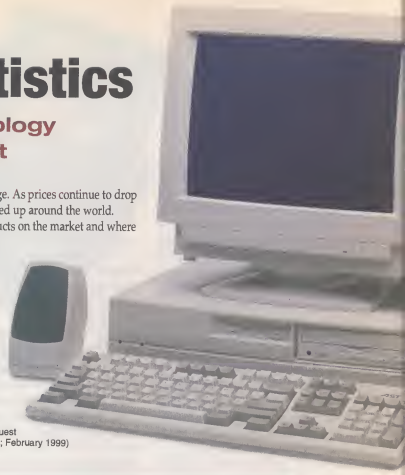
The computers of the future will build upon the technological advances of today by making computers intelligent enough to configure themselves to do tasks no matter where their users are or what the situation is. The idea is to give people the technology they need to be productive without forcing them to worry about installation, configuration, or complex maintenance. Looking forward, we can see an endless line of possibilities stretching out over the horizon, and only one thing seems certain: Computers will continue to increase the productivity and the quality of life for their users in the future just as they have in the past and are doing today. ■

by Chris Trumble

Computer Statistics

A Brief Look At The Technology & Trends In Today's Market

The computer industry is, if nothing else, an industry of change. As prices continue to drop and manufacturers develop new products, markets are opened up around the world. Here, you'll find a synopsis of some of the players and products on the market and where consumers are spending their money.



U.S. Households With PCs

Source: DataQuest
(Gartner Group; February 1999)

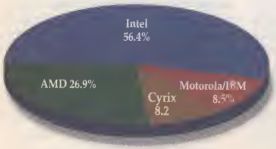
Top 5 PC Vendors (worldwide PC shipments, first quarter 1999)

Company	Units Shipped	Market Share	One-Year Growth
Compaq	3.5 million	14.5%	16%
Dell	2.5 million	10%	52%
IBM	2.2 million	8.9%	30%
Hewlett-Packard	1.59 million	6.5%	16%
NEC/Packard-Bell	1.57 million	6.4%	6%

Source: International Data Corp.

Top 4 CPU Manufacturers In Desktop Units (1998)

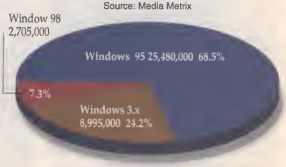
Source: PC Data



The various incarnations of the Microsoft Windows operating system have dominated the market for some time. Recently, however, a new competitor has emerged: Linux. Although this operating system is used primarily in larger corporations and is not yet a significant threat to Microsoft's stronghold on the desktop, some sources estimate more than 10 million people are using Linux worldwide. Linux developers continue to work on a home user-friendly version.

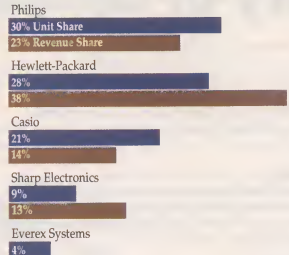
Windows Installed Base In U.S. Households (November 98; percentages reflect Windows PCs only)

Source: Media Metrix



Total Windows: 37,223,000

Top 5 Handheld PC Vendors (1998)



Source: PC Data

Top 10 Software Titles (Units Sold in 1998)

Title/Manufacturer
Windows 98 Upgrade *Microsoft*
TurboTax *Intuit*
TurboTax Deluxe *Intuit*
Starcraft *Havas Interactive*
Quicken Deluxe *Intuit*
Deer Hunter *GT Interactive*
VirusScan 3 *Network Associates*
TaxCut *Block Financial*
TurboTax Multi State *Intuit*
Myst *Learning Company*

Source: PC Data

Software Piracy Losses (projected, in billions of dollars)

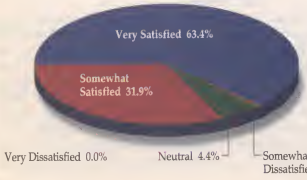
	1999	2001	2003	2005
Africa	0.1	0.1	0.2	0.3
Asia/Pacific	4.1	6.9	17.2	37.5
Europe	2.7	3.9	5.4	7.5
Middle East	0.1	0.1	0.1	0.2
North America	3.4	4.5	5.9	8.3
South America	0.3	0.5	0.8	1.4
Worldwide	10.6	16.1	29.7	55.1

Source: Computer Economics

Information compiled by Marty Sems

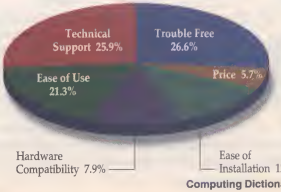
Satisfaction Levels With Present Linux Version

Source: WebCMO (September-October 1998)



Why Linux Users Are Satisfied

Source: WebCMO (September-October 1998)



A Journey Through

The History Of Computers

The invention of computers began before the discovery of electricity. Thousands of years ago, people started seeking easier ways to add and subtract. Though counting with beads may seem a long way from the World Wide Web, the ideas of these first inventors helped foster the technology that has led the computer industry to where it is today.

In the following timeline, we'll trace that evolution, highlighting major discoveries and events along the way. If you want more information about some of the people listed in this timeline, see "Who's Who In The Computing World" in this issue.

B.C.

ca. 500

The bead-and-wire abacus, used for adding and subtracting large numbers, is invented in Egypt.

A.D.

ca. 800

Chinese start to use the number zero.

1474

The first patent statute enacted in Venice.

ca. 1500

The quadrant, an astronomical and calculational tool, becomes popular in Europe.

1502

The first watch is invented.

1608

The telescope is accidentally invented by Dutch spectacle maker Hans Lippershey.

1617

Scotland's John Napier introduces a system of multiplying by adding numbers and dividing by subtracting. The system, which was called "Napier's Bones," was a mechanical numbering device made of horn, bone, or ivory.

1622

William Oughtred of England invents the circular slide rule.

1623

Germany's Wilhelm Schickard invents the first workable mechanical calculating machine. It's able to add and subtract automatically and multiply and divide semiautomatically.

1624

Professor Henry Briggs of England publishes the first set of modern logarithms, which contains 1,161 errors.

1628

Dutchman Adrian Vlacq fills in the missing pieces to Henry Briggs' work by publishing the first complete set of modern logarithms.

1642

France's Blaise Pascal invents a machine, called the Pascaline, that can add, subtract, and carry between digits. The machine also is used to calculate the exchange rate of national currencies.

1666

Gaspard Schott of Germany creates an Organum Mathematicum, a mathematical mechanical aid that expanded upon "Napier's Bones."

1672

England's Samuel Morland publishes "The Description and Use of Two Arithmetic Instruments," which describes adding machines and a mechanical version of "Napier's Bones."

1674

Gottfried Wilhelm Leibnitz of Germany creates a machine that can add, subtract, multiply, and divide automatically.

1780

American Benjamin Franklin discovers electricity.

1804

Frenchman Joseph-Marie Jacquard completes his fully automated loom, which is programmed by punched cards.

1820

Thomas de Colmar creates the first reliable, useful, commercially successful calculating machine. Over the next 60 years, more than 1,500 of these machines are sold.

1822

England's Charles Babbage begins work on the Difference Engine, which is a device used for producing calculating tablets.

1830s

The electric telegraph is invented in England and the United States.

1833

All work on the Difference Engine ends, after a dispute between Charles Babbage and his partner Joseph Clement. Babbage begins designing the Analytical Engine, a device that he said would be able "to solve any equation." He died before the machine was completed.

1853

The Swedish father-and-son team of Georg and Edvard Scheutz completes construction of an operational Difference Engine modeled after Charles Babbage's plans.

1866

The first successful trans-Atlantic cable is laid, stretching from Ireland to Newfoundland.

1867

The typewriter is invented in the United States.

1875

A company called Tanaka Seizo-sho is established in Japan. The company, which

manufactures telegraphic equipment, later merges with another company called Shibaura Seisaku-sho to form Tokyo Shibarura Denki. Today, that name has been shortened to Toshiba, a worldwide manufacturer of computer products (among other things).

ca. 1875

The first properly constructed variable-toothed gear—which will result in a breakthrough in the calculating machine industry—is made.

1876

Alexander Graham Bell is granted a patent for his telephone.

1877

The microphone is invented in the United States.

1883

American Thomas Edison discovers the Edison effect, in which electric current flows through a vacuum.

1884

American Dorr E. Felt begins work on the Comptometer, a calculator that would tally results as numbers were entered.

1886

Ottmar Mergenthaler invents the Linotype machine, which produces complete lines of metal type.

1888

William S. Burroughs patents a printing adding machine.

1890

American Herman Hollerith's method of using punched cards to tabulate data is used in the U.S. census.

1891

Henri Genaille's and Edouard Lucas' rulers, similar to "Napier's Bones," are marketed.

1896

Herman Hollerith starts the Tabulating Machine Co., essentially the world's first computer company, which in a roundabout way would eventually become International Business Machines (IBM).

1901

The first radio message (which is a repeated transmission of three-dot Morse code for S) is sent across the Atlantic Ocean.

1903

Yugoslav-American Nikola Tesla, an employee of Thomas Edison, patents the electrical logic circuits that become crucial to addition, subtraction, and multiplication in later machines.

1911

Four New York manufacturing companies merge to form the Computing-Tabulating-Recording Co. (among them, Herman Hollerith's Tabulating Machine Co.).

1920

Czech playwright Karel Capek coins the term "robot" to describe mechanical workers.

Radio broadcasting begins in Pittsburgh, Pa., at station KDKA.

1921

Radio Shack opens its first store in Boston.

1924

The Computing-Tabulating-Recording Co. changes its name to International Business Machines (IBM).

1925

MIT's Vannevar Bush creates the differential analyzer, a large-scale analog calculator that can do many kinds of scientific computations.

1927

The television is publicly demonstrated at Bell Telephone Laboratories.

1928

Paul V. Galvin founds the Galvin Manufacturing Corp. in Chicago. The company produces battery eliminators, which allow radios to run on normal household current.

L. J. Comrie uses punched cards to calculate the motions of the moon.

GE broadcasts "The Queen's Messenger," the first dramatic production on television.

1929

Sales of radio sets reach $900 million, up from $60 million in 1922.

1930

Vannevar Bush's differential analyzer is introduced as the first serious attempt to design a computer that can do many kinds of scientific computations; it is the herald of the modern computer age.

1932

Cambridge physics professor Dr. C. E. Wynn-Williams is the first to use large-scale electronic counters for constructing a binary counter to keep track of events in experiments.

1934

The idea that an automatic calculator would only need a control program, a memory, and an arithmetic unit is advanced by Konrad Zuse, a famous German civil engineer.

The Communications Act of 1934 creates the Federal Communications Commission (FCC), the agency that will regulate interstate and international communications, including telecommunications.

1936

Alan Turing publishes his landmark paper "On Computable Numbers," in which he outlines what is basically the modern computer.

German Konrad Zuse, who sets up a workshop in his parents' apartment, applies for a patent on his mechanical memory, a simple device based upon pins that can be pushed from one side of a slot to another, denoting binary one or zero.

1937

Michigan-born Claude Shannon writes an influential paper that sets the stage for digital computers, linking symbolic logic and electrical circuits.

1938

Konrad Zuse of Germany creates the Z1, one of the first binary digital computers and a machine that could be controlled through a punch tape.

1939

George Stibitz at Bell Telephone Laboratories completes the Complex Number Calculator,

which uses Boolean logic to add, subtract, multiply, and divide complex numbers and also provides a foundation for digital computers.

The first Radio Shack catalog is published.

Iowa State College's John Vincent Atanasoff and Clifford Berry have a prototype of the binary-based ABC (Atanasoff-Berry Computer), which is often considered the first automatic digital computer.

William Hewlett and David Packard found Hewlett-Packard and produce their first product, a resistance-capacitance audio oscillator that was purchased by Disney to make the sound track for the film "Fantasia." The company would later become famous for its profitable line of desktop printers.

1940

George Stibitz's Complex Number Calculator is the first machine to be used from a remote location, when it is demonstrated via a remote terminal at the American Mathematical Association Meeting.

The National Defense Research Committee is established to organize scientists and engineers for World War II.

Motorola produces a "Handy-Talkie," the first handheld two-way radio, for the U.S. Army Signal Corps.

1941

German Konrad Zuse finishes the Z3, a fully operational calculating machine with automatic control.

1942

John Mauchly, a professor of physics at Ursinus College in Pennsylvania, writes a short paper entitled "The Use of High Speed Vacuum Tube Devices for Calculating."

1943

J. Presper Eckert and John Mauchly begin construction of the Electronic Numerical Integrator And Computer (ENIAC), the first general-purpose electronic digital calculator. The ENIAC is considered by some to be the first electronic computer and will be used to calculate ballistic firing tables during World War II.

The Colossus, which was a programmable, digital machine also considered by some to be the first electronic computer, is operational in England.

In England, Dr. C. E. Wynn-Williams agrees to design a wartime code-breaking machine. He calls it "Heath Robinson" after a famous cartoonist known for inventing unique machines.

Motorola's Dan Noble designs a "Walkie-Talkie," the first portable FM two-way radio. As opposed to the lighter "Handie-Talkie," the FM version is a 35-pound backpack version.

An analog flight simulator project called "Project Whirlwind" is developed at MIT.

1944

The relay-based Harvard-IBM MARK I, a program-controlled, large-scale calculating machine built by a team led by Howard Aiken, goes to work during World War II providing vital calculations for the U.S. Navy. Grace Hopper becomes its first programmer.

Several copies of the Colossus are installed at London's Bletchley Park, five days before the Allies land at Normandy. Alan Turing will lead the team that uses the machine to crack top-secret German codes.

1945

Hungarian John von Neumann participates in the creation of the EDVAC (Electronic Discrete Variable Automatic Computer), a computer capable of storing programs internally and using electronic speed. Von Neumann is often credited with the concept of storing programs.

Atlantic Monthly publishes Vannevar Bush's landmark essay "As We May Think," which describes a desk that gives instant access to documents, books, and periodicals stored in microfilm.

While working on the construction of the MARK II, Grace Hopper discovers a large moth that has made a relay fail. She tapes the moth in the log book with a note that says, "First actual case of bug being found." Hers is not the first use of the word "bug" in this manner; Hopper was just making a joke.

The flight simulator "Project Whirlwind," started in 1943, is switched from analog to digital electronics.

1946

J. Presper Eckert and John Mauchly unveil the ENIAC at the University of Pennsylvania's Moore School of Electrical Engineering. Later the same year, Eckert and Mauchly leave the Moore School to found their own firm, Electronic Control Co., to design the UNIVAC.

Alan Turing, a code-breaking specialist during World War II, designs the Automatic Computing Engine (ACE), and Jim Wilkinson is assigned to help him at the National Physical Laboratory.

John von Neumann pioneers a computer project at the Institute for Advanced Study at Princeton, attempting to develop a digital computer.

The Royal Society awards a grant to found a Computer Laboratory at Manchester University, and Tom Kilburn and Frederic Williams join the project to explore the possibilities of creating an electronic, digital computer. The two will build the SSEM (small-scale electronic machine).

F. C. Williams applies for a patent on his cathode-ray tube (CRT) storing device, an original form of random-access memory (RAM).

Based upon the ideas behind the EDVAC, construction of the Cambridge Machine, also known as the Electronic Delay Storage Automatic Calculator (EDSAC), is begun.

1947

John Bardeen, Walter Brattain, and William Shockley invent the transresistor, or transistor, at AT&T Bell Telephone Laboratories. The transistor has the same capabilities as a vacuum tube but is faster, breaks less often, uses less power, and creates less heat.

The Harvard-MARK II, an expensive machine that is considerably faster than the MARK I, goes into operation, again under the direction of Howard Aiken.

Northrup Aviation completes contract agreement with the Electronic Control Company

for BINAC (BINary Automatic Computer), which among other things was the first computer to use magnetic tape as a secondary memory.

F. C. Williams' memory system, which was patented in 1946, is now in working order.

Norbert Wiener coins the term "cybernetics," which refers to "the science of control and communication in the animal and the machine."

1948

Claude Shannon writes an influential paper founding information theory, which is based upon the idea of the bit being the fundamental unit of data.

The prototype of the SSEM (small-scale electronic machine) is in operation at Manchester University. Alan Turing joins the SSEM project, which some consider to be the first electronic computer.

IBM builds the Selective Sequence Electronic Calculator (SSEC), a computer with 12,000 tubes.

Andrew Donald Booth realizes that one of the major problems with the computers designed so far is the lack of storage. He then creates magnetic drum memory, which is two inches long and two inches wide and capable of holding 10 bits per inch.

An agreement is made between Eckert-Mauchly Computer Corp., previously known as the Electronic Control Co., and the U.S. Census Bureau for the production of the UNIVersal Automatic Computer (UNIVAC). The computer will be used to aid the Bureau with its large amounts of statistical gathering.

The National Bureau of Standards, impatient for commercial computers to appear, begins work on the Standards Eastern Automatic Computer (SEAC).

The 604 multiplying punch, based upon vacuum tube technology, is produced by IBM.

Television is starting to divert radio's audiences.

1949

The EDSAC, built by Maurice Wilkes at Cambridge University, makes its first run. Considered by some to be the first electronic computer, the EDSAC is personified by a stored memory.

The National Bureau of Standards Institute for Numerical Analysis starts on the SEAC's counterpart, the Standards Western Automatic Computer (SWAC).

Pilot ACE, a pilot project for the rapid and complex Automatic Computer Engine, is going through production at the National Physical Laboratory in Teddington, England. The design of ACE is largely credited to Alan Turing.

Claude Shannon builds the first machine that plays chess at the Massachusetts Institute of Technology.

The Harvard-MARK III, the first of the MARK machines to use an internally stored program and indirect addressing, goes into operation, once again under the direction of Howard Aiken.

Jay Forrester uses iron cores for the main memory in Whirlwind. This magnetic form of memory will be used practically in 1952 and '53.

Northrup Aviation receives BINAC from Eckert-Mauchly Computer Corp. BINAC was the first computer to operate in America; however, some say the machine never worked the way it was supposed to.

The SSEM (small-scale electronic machine) at Manchester University is fully operational.

1950

Hideo Yamachito leads a team that will create Japan's first, large, electronic computer, the Tokyo Automatic Calculator (TAC).

The SEAC (Standards Eastern Automatic Computer) is delivered to and goes into operation at the National Bureau of Standards. Its memory is capable of storing 512 45-bit words.

The National Physical Laboratory begins operating the Pilot ACE.

The SWAC (Standards Western Automatic Computer) is now operational. The western complement to the SEAC, the SWAC is now the fastest computer in the world.

The enhanced Z4 is installed by Konrad Zuse at the Federal Polytechnical Institute (ETH) in Zurich. The Z4 can simultaneously perform an operation and read the next two in line.

Alan Turing, using the Interrogator machine, puts a computer and a human in a room to answer questions. According to his theory, known as the Turing Test, if the computer can pass for a human in its answers, it proves that the computer can think. No computer has yet passed this test.

1951

Whirlwind, which is used for problems requiring real-time work, is in operation at the U.S. Navy's Office of Research and Invention.

An Wang of China founds Wang Laboratories Inc. in Boston. The company would later become a major computer manufacturer.

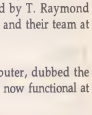
The 7-foot x 19-foot SSEM (small-scale electronic machine) is dismantled because Manchester University needs the space.

The first business computer, a Lyons Electronic Office (LEO), is completed by T. Raymond Thompson, John Simmons, and their team at the Lyons Co.

The first commercial computer, dubbed the "First Ferranti MARK I," is now functional at Manchester University.

The first computer sold commercially in the United States, the UNIVAC, is installed at the U.S. Census Bureau. It's capable of performing 8,333 additions or 555 multiplications a second.

The Institute for Advanced Study (IAS) machine is now in limited operation. The initial test for the IAS involves calculations integral to the design of the hydrogen bomb.



1952

The Harvard-MARK IV, the last of Howard Aiken's machines and the one with

an increased speed because of its ferrite magnetic cores, is in operation at Harvard University.

Andrew Donald Booth and his father sell fairly reliable working magnetic drum memories for use in computers.

MANIAC and ORDVAC, two versions of the Institute for Advanced Study (IAS) machine, are now functional.

With only 7% of the votes in, the UNIVAC correctly predicts that Dwight D. Eisenhower will win the presidential race, leading to a widespread realization of the possibilities of computers.

The Ferranti MARK I, also known as the Manchester Electronic Computer MARK II (a copy of the original MARK I, not an improvement), is installed at the University of Toronto.

IBM World Headquarters receives the first IBM 701. The machine has 256 40-bit words of main memory and can perform 2,200 multiplications per second.

The Moore School finally has a finished version of the EDVAC, with a clock speed of one megahertz (MHz).

1953

A magnetic memory smaller and faster than existing vacuum tube memories is built at MIT.

The 701 becomes available to the scientific community. A total of 19 are produced and sold.

1954

IBM produces and markets the 650, a useful workhorse computer. The company produces more than 1,800 in an eight-year span.

IBM publishes the first version of FORTRAN (formula translator) and begins work on FORTRAN II. The influential FORTRAN, created by a team led by John Backus, will be considered the first true high-level programming language.

DEUCE, a flight simulation package, is constructed by English Electric.

Texas Instruments physicist Gordon Teal perfects a way of making transistors out of inexpensive silicon instead of more costly germanium.

1955

Dartmouth College's John McCarthy coins the term "artificial intelligence."

Bell Labs introduces its first transistor computer. Transistors are faster, smaller, and create less heat than traditional vacuum tubes, making these computers much more efficient.

The ENIAC is turned off for the last time. It's estimated to have done more arithmetic than the entire human race had done prior to 1945.

1956

Bell Labs scientists John Bardeen, Walter Brattain, and William Shockley share the Nobel Prize in physics for inventing the transistor.

The Livermore Atomic Research Computer (LARC) is under development at UNIVAC, a company that competes with IBM. The LARC will be the last major effort to create a machine based upon the decimal-only memory storage concept.

IBM's 305 RAMAC, the first computer with a hard disk drive, is shipped.

Manchester University begins the ATLAS computer project, a design for an efficient supercomputer capable of primitive multitasking.

1957

Kenneth Olsen founds Digital Equipment Corp., which will later become a major network computer manufacturer on par with the likes of IBM.

Cornell University begins the first computerized concordance, indexing the work of English poet and critic Matthew Arnold.

The *GPS* (*General Problem Solver*) program is written by Allen Newell, H. A. Simon, and J. C. Shaw. This ambitious program is made to potentially solve all problems.

John McCarthy creates the LISP programming language, which is said to represent commonsense knowledge and becomes associated with the growing field of artificial intelligence.

Philco delivers the TRANSAC S-2000, one of the first transistorized computers.

Russia launches the first artificial satellite, named Sputnik.

1958-59

Inventors at Fairchild Semiconductor and Texas Instruments are simultaneously creating the integrated circuit, which combines the necessary components of a computer into one unit, thereby saving space, doing away with the need for wiring components together, and increasing reliability.

1958

The National Advisory Committee for Aeronautics is renamed the National Aeronautics and Space Administration (NASA).

President Eisenhower's Christmas address is the first voice transmission from a satellite.

1959

The Harvard-MARK I is turned off for the last time.

Most of the manufacturers of scientific machines have adopted the successful FORTRAN language rather than be faced with trying to produce a new language that is as good.

1959-60

Motorola produces the two-way, fully transistorized mobile radio.

1960

IBM's 1400 series machines, aimed specifically at the business market, are being distributed.

The COBOL (Common Business-Oriented Language) programming language is invented. One of the unique facets of COBOL is its attempt to stay close to the spoken language.

Psychologist Frank Rosenblatt creates the Mark I Perceptron, which has an "eye" that can learn to identify its ABCs.

1961

The first Stretch computer, a computer with 100 times the power of any computer in production, is delivered to Los Alamos, N.M.

Hewlett-Packard stock is accepted by the New York Stock Exchange for national and international trading.

Jay Forrester, the author of "Industrial Dynamics," explains how the DYNAMO programming language can help manage a company.

General Motors puts the first industrial robot—the 4,000-pound Unimate—to work in a New Jersey factory.

1962

Fairchild Semiconductor and Texas Instruments begin mass-producing the integrated circuit.

Manchester University installs the first ATLAS computer. One of ATLAS' unique traits is an early form of virtual memory.

For the first time, IBM's U.S.-based annual computer revenue (at $1 billion) surpasses its other revenue.

A NASA rocket, the Mariner II, is equipped with a Motorola transmitter on its trip to Venus.

The APL (A Programming Language), which is a way of notating mathematical formulas on the computer, is invented.

The New York Times, foreseeing a "global newspaper," sends pages to its edition in Paris via photo facsimile.

1963

Doug Engelbart invents and patents the first computer mouse.

Integrated circuits make their appearance in a commercial product: the hearing aid.

The Institute of Electrical and Electronic Engineers (IEEE), an association of engineers, scientists, and students, is founded.

The American Standard Code for Information Interchange (ASCII) is developed to standardize data exchange among computers.

1964

Dartmouth University's John Kemeny and Thomas Kurtz develop BASIC (Beginner's All-purpose Symbolic Instruction Language) because they want a simple computer programming language.

The PL/1 programming language, a supposed "Super Language," is invented. It is a combination of FORTRAN and COBOL.

The first computerized encyclopedia is invented at the Systems Development Corp.

Motorola equipment is used to retrieve images of Mars.

The picture-phone is first displayed at the New York World's Fair.

American Airlines and IBM introduce the Semi-Automated Business Research Environment, or SABRE, which computerizes the airline reservation system. It operates in real-time and can transmit flight information in seconds.

1965

Ted Nelson coins the term "hypertext," which refers to text that is not necessarily linear.

Digital Equipment's PDP-8 is the first minicomputer.

Donald Davies invents "packet switching," which is a new concept for computer communications. Packet switching involves breaking down a message or information into small pieces and sending them to a new location over communications lines. The technology will play an integral part in the premise of the Internet.

Harvard and MIT start computer dating services, and Dartmouth begins a computer dating rating service.

The number of British patent applications reaches 55,507, up from about 26,000 in 1900 and 100 in 1800.

1966

MIT's Joseph Weizenbaum writes a program, called *ELIZA*, that makes the computer act as a psychotherapist.

The first personal computer club, the Amateur Computer Society, is established by Stephen B. Gray. The group publishes the *ACS*, which will be considered the first personal computer newsletter.

1967

IBM creates the first floppy disk.

The LOGO programming language is developed. LOGO will later be known for its "turtle graphics," a simplified interface useful for teaching children and computer "newbies."

1968

Robert Noyce and Gordon Moore co-found Intel Corp., which will be known for the microprocessor.

Seiko markets a miniature printer for use with calculators.

1969

Control Data Corp., led by Seymour Cray, releases the CDC 7600, which is often considered to be the first supercomputer.

Unix, a free operating system still in use today, is developed by AT&T Bell Laboratories.

Gary Starkweather, while working for Xerox, invents the laser printer.

A Motorola transponder transmitter is used to relay Neil Armstrong's words from the moon to Earth.

The U.S. Department of Defense sets up the ARPANet (Advanced Research Projects Agency), a network able to withstand partial destruction from bombs or other disasters and still function. This was the Internet in its fledgling stage.

Jean Sammet publishes "Programming Languages: History and Fundamentals," which many consider the standard book about programming languages.

CompuServe, the first commercial online service, is established.

Seiko develops the world's first quartz wristwatch.

Shakey, a fully mobile but wobbly and slow robot, makes the rounds at the Stanford Research Institute.

1970

Intel announces the 1103, a new memory chip containing more than 1,000 bits of information. This chip is classified as random-access memory (RAM), which means the user can write instructions into the computer's memory.

The Xerox Palo Alto Research Center (PARC) is established to perform basic computing and electronics research.

The first ATM gets a lukewarm response in Georgia.

1971

The first microprocessor, the Intel 4004, is designed. This single chip contains all the basic parts of a central processor.

The Pascal programming language is invented by Niklaus Wirth. The program, a compact, step-by-step language, is used primarily as a teaching tool.

Micro Instrumentation and Telemetry Systems (MITS) begins producing the first large-scale integrated calculator kit in the United States.

1972

Philippe Rouseel invents PROLOG, a new type of programming language, for the Artificial Intelligence Group at the University of Marseilles.

Atari releases *Pong*, the first commercial video game, with *Asteroids* soon to follow.

Dennis Ritchie at Bell Labs invents the C programming language. C will become the practical standard in microcomputers and workstations.

Radio Shack introduces its first calculator.

The compact disc is invented in the United States.

1973

The term "microcomputer" appears in print.

Robert Metcalfe creates the Ethernet, a local-area network (LAN), to link the minicomputers at the Xerox Palo Alto Research Center (PARC). As of 1995, the Ethernet connected more than 50 million computers.

Interactive laser discs make their debut.

Wang Laboratories releases the easy-to-use Wang Word-Processing System, which includes a keyboard, printer, and storage device.

1974

Intel's improved microprocessor chip, the 8080 (which is designed for general use), becomes the standard in the microcomputing industry.

The first Toshiba floppy disk drive is introduced.

Jack S. Kilby, Jerry D. Merryman, and James Van Tassel of Texas Instruments are granted the patent for the electronic handheld calculator.

1975

MITS ships one of the first PCs, the Altair 8800 with one kilobyte (KB) of memory, as a $397 mail-order kit.

Edward Roberts and his company (Micro Instrumentation and Telemetry Systems [MITS]) are said to have coined the term "personal computer."

Paul Allen and Bill Gates write the first computer language program for personal computers, which is a form of BASIC designed for the Altair. Gates drops out of Harvard and founds Microsoft with Allen.

MOS Technology 6502 (which is fast, powerful, and cheap) is widely used in popular home computers. This technology adds two 8-bit numbers in a millionth of a second.

The Byte Shop, one of the first computer stores, opens in California. About two years later, owner Paul Terrell will sell a chain of 74 Byte Shops for $4 million.

U.S. air traffic control is fully computerized.

1976

Steve Wozniak and Steve Jobs found Apple Computer, which will become a multimillion dollar company and play a major role in the computer industry.

Bill Gates publishes a letter in the Altair user newsletter, complaining about illegal copies of BASIC.

Microsoft introduces an improved version of BASIC.

The first convention of computer hobbyist clubs is held in New Jersey.

1977

Apple Computer Inc., Radio Shack, and Commodore all introduce mass-market computers, beginning the PC era and the microcomputer race.

Apple Computer's Apple II, the first personal computer with color graphics, debuts, and the now-famous Apple logo is designed by Rob Janoff of Regis McKenna Advertising.

Commodore announces that the $495 PET (Personal Electronic Transactor) will be a self-contained unit, with a central processing unit (CPU), random-access memory (RAM), read-only memory (ROM), keyboard, monitor, and tape recorder all in one package.

Radio Shack's TRS-80 Model I Microcomputer is introduced. Radio Shack calls a press conference at the New York Stock Exchange to announce its debut, but a bomb goes off three blocks away, and Radio Shack is unable to make the announcement.

Microsoft sells the license for BASIC to Radio Shack and Apple and introduces the program in Japan.

In Morristown, N.J., a computer retail franchise opens under the name Computer Shack. The company is later renamed ComputerLand (after opposition from Radio Shack) and becomes a leading hardware and software outlet.

A week-long computer camp—the first of its kind—takes place in Indiana.

1978

Epson introduces the TX-80, which is the first commercially successful dot matrix printer for personal computers.

Microsoft introduces a new version of COBOL.

Microsoft and ASCII Corp. in Japan begin an operating agreement, making ASCII Microsoft's first Far East connection.

Intel invents the 8086. It uses 29,000 transistors, costs $360, and can access one megabyte (MB) of memory.

The 5.25-inch floppy disk is the industry standard.

Ward Christensen and Randy Seuss have the first major microcomputer bulletin board up and running in Chicago.

New York City is home to the first Personal Computer Expo.

1979

Software Arts Inc.'s *VisiCalc*, the first electronic spreadsheet and business program for PCs, is released.

Epson improves upon the TX-80 with another dot matrix printer, the MX-80, which soon becomes an industry standard.

The Motorola 68000, one of the most powerful and versatile 16-bit chips, performs multiplication as a single operation rather than multiple addition operations and adds two 16-bit numbers in 240 billionths of a second.

The Apple II Plus is introduced. It has 48 kilobytes (KB) of memory and sells for around $1,200.

Texas Instruments enters the microcomputer market with the TI 99/4 personal computer, which sells for $1,500.

Hayes markets its first modem, which sets the industry standard for modems in years to come. Most modems produced today are Hayes-compatible.

Atari introduces a coin-operated version of *Asteroids*.

More than half a million computers are in use in the United States.

1980

IBM hires Paul Allen and Bill Gates to create an operating system for a new PC. The pair buys the rights to a simple operating system manufactured by Seattle Computer Products and use it as a template. IBM allows Allen and Gates to retain the marketing rights to the operating system, called DOS.

MS-DOS (Microsoft's version) and PC DOS (IBM's version) soon become the most popular operating systems.

Microsoft licenses Unix and starts to develop a PC version, XENIX.

IBM hires Microsoft to develop versions of BASIC, FORTRAN, COBOL, and Pascal for the PC being developed by IBM.

The first Tandy Color Computer is introduced.

John Bell invents the first easy database program, the *Personal Filing System* (*PFS*), to run on Apple II computers.

More than 1 million computers are in use in the United States.

1981

IBM joins the personal computer race with its IBM PC, which runs the new DOS operating system.

BITNET, one of the first wide-area networks (WAN), is founded to serve academic institutions. It will become the largest computer network before being overshadowed by the Internet.

Microsoft establishes a national retail sales network and formally incorporates, becoming Microsoft Inc.

Xerox introduces the graphical Star workstation, which greatly influences the development of Apple's future computer models, Lisa and Macintosh, as well as Microsoft's Windows.

Hayes introduces the Smartmodem 300 with its standard-setting AT command set and an operating speed of 300 bits per second (bps).

Adam Osborne introduces the Osborne I, the first successful "portable" computer, which weighs 25 pounds.

The Hewlett-Packard Superchip, the first 32-bit microprocessor, adds two 32-bit numbers in 55 billionths of a second.

Commodore ships the VIC-20, soon to be the world's most popular computer, at $299.95.

Logitech, a computer peripherals company, is founded in Apples, Switzerland.

Hayes releases the Smartmodem 1200, which transfers data at 1,200 bits per second (bps).

1982

Peter Norton creates *Norton Utilities*, a file recovery program.

Microsoft releases FORTRAN for the PC, COBOL for MS-DOS, and Multiplan for the Apple II and CP/M machines.

Microsoft establishes a subsidiary in England, Microsoft Ltd., beginning a foreign sales effort.

WordPerfect 1.0, a word processing program that will become one of the market's most popular, is introduced by WordPerfect Corp.

Lotus Development Corp. is founded, and *Lotus 1-2-3*, a spreadsheet program, is introduced.

Compaq Computer Corp. is founded by Rod Canion and other Texas Instruments Inc. engineers. Compaq introduces the first portable clone of the IBM PC and becomes IBM's biggest challenger in the corporate market.

Commodore begins selling the Commodore 64, an improvement on the VIC-20. It contains 64 kilobytes (KB) of random-access memory (RAM) and contains Microsoft BASIC as an operating system. In the next year, the price drops from $600 to $200, helping to make it the best-selling computer of all time.

Epson introduces the HX-20, the first notebook-sized portable computer.

MS-DOS version 1.25 is released. The installed user base for MS-DOS is 232,000.

Six-year-old Apple Computer is the first personal computer manufacturer to hit the $1 billion mark for annual sales.

1983

The PC is *Time* magazine's "man of the year."

The Apple IIe is introduced. With 64 kilobytes (KB) of random-access memory (RAM), a one megahertz (MHz) 6502 processor, and running Applesoft BASIC, it sells for $1,400.

Microsoft releases *Microsoft Word* 1.0, a word processing program that will become one of the market's most popular.

Lotus Development Corp.'s *Lotus 1-2-3* becomes the spreadsheet software of choice, ousting *VisiCalc*, the spreadsheet that had first presented a reason for many users to buy a PC.

Tandy, Epson, and NEC all sell notebook computers, but only Tandy's (the Model 100) becomes popular because of its lower price ($499) and easier-to-use interface.

PC-Draw, the first IBM PC-based graphics program, is introduced.

More than 10 million computers are in use in the United States.

1984

Appleworks, a suite of programs containing a word processor, database manager, and spreadsheet, is released.

Microsoft's Bill Gates is featured on the cover of *Time* magazine.

The 3.5-inch diskette debuts and eventually becomes the industry's preferred diskette size.

Hewlett-Packard's LaserJet laser printer, which retails for $3,495, brings high-quality printing to PCs.

Hayes introduces *Smartcom II*, which is communications software for the IBM PC, to be used with Hayes modems. Software for modems lets users automatically dial or answer calls, transfer and process data, and disconnect calls. Hayes releases a modem capable of sending data at 2400 bits per second (bps).

Dell Computer is founded in Austin, Texas. The company will later become a major force in mail-order computer sales.

The Apple II compact computer is introduced. With 128 kilobytes (KB) of random-access memory (RAM) and a 5.25-inch diskette drive, the system weighs just 7.5 pounds and costs $1,300.

In a commercial during the Super Bowl, Apple Computer introduces the Macintosh, a computer with a graphical user interface. Instead of typing commands, users select options with a mouse or other pointing device. In six months, sales of "the computer for the rest of us," as the advertisements call it, reach 100,000.

The Computer Museum opens in downtown Boston.

Microsoft introduces MS-DOS 3.0 for the IBM PC AT and MS-DOS 3.1 for networks; Multiplan, BASIC, and *Word* 1.0 for the Macintosh; and *Project* (a project planning and management applications package) and *Chart* (a graphics program) for the PC and Macintosh.

The Tandy 1000 personal computer is introduced and becomes the best-selling IBM-compatible computer of the year.

IBM introduces the Enhanced Graphics Adapter (EGA) video card with higher resolution, more colors, and a quicker response than previous video cards.

University of Southern California professor Fred Cohen creates alarm when he warns the public about computer viruses.

Seiko introduces the first wristwatch computer.

1985

Microsoft and IBM begin collaborating on a next-generation operating system (OS/2).

The computer company Gateway 2000 is founded in Sioux City, Iowa. The company later becomes a major force in mail-order computer sales.

IBM releases the Topview graphical environment, the precursor to OS/2's graphical interface.

Intel introduces the 80386, a 16-megahertz (MHz) processor that incorporates 275,000 transistors. The processor sells for $299 and is able to access four gigabytes (GB) of memory.

Aldus Corp. introduces *PageMaker* for the Macintosh, a program that lets users mix type and graphics on a page. The combination of this software and the new Apple LaserWriter laser printer begin the era of desktop publishing.

Microsoft Windows 1.0 is shipped. Selling for $100, it provides a much easier interface for users to navigate.

Microsoft introduces more than 20 new computer languages, operating system versions, software products, and computer books.

Quarterdeck's *DESQview* is the first software to bring multitasking and windowing capabilities to DOS applications.

In A Vision, the first graphics program for Microsoft Windows, is introduced; Micrografx is the first independent vendor to market a Windows-based product.

The Nintendo Entertainment System makes its debut.

1986

Apple introduces Mac Plus. It contains one megabyte (MB) of random-access memory (RAM), sells for $2,600, and includes a new keyboard that contains cursors and a numeric keypad.

Compaq introduces the first 386-based PC-compatible computer, beating IBM to the 80386 market.

More than 30 million computers are in use in the United States.

IBM introduces its first laptop computer, the PC Convertible, which has 256 kilobytes (KB) of random-access memory (RAM), two 720KB diskette drives, and sells for $2,000. However, it's Toshiba's laptop clone that becomes the hit.

Microsoft is listed on the New York Stock Exchange. It sells shares to the public at $21 each, making Bill Gates the world's youngest billionaire.

1987

Hayes demonstrates its ISDN (Integrated Services Digital Network) adapter, which is a modem for ISDN lines, providing speeds up to four times greater than the fastest modem on a telephone line.

Microsoft purchases Forethought Inc., the company that developed the presentation software *PowerPoint*. *PowerPoint* becomes available for Macintosh and PC and as part of *Microsoft Office*.

Microsoft introduces Windows 2.0 and *Microsoft Works*. *Works* is an integrated applications package for new users and includes a word processor based upon *Microsoft Word*, a spreadsheet based upon *Multiplan* and *Excel*, and a database.

Microsoft and IBM release OS/2 1.0 and claim it will replace MS-DOS.

Microsoft stock hits $100 per share.

The expandable Mac SE is introduced at $2,900.

IBM introduces the PS/2 personal computer, which has improved graphics, a 3.5-inch diskette drive, and a proprietary bus to help fend off the clone makers.

IBM sends clone manufacturers letters demanding retroactive licensing fees.

The Computer Security Act is passed, requiring that federal agencies develop computer security plans to protect sensitive, but unclassified, information and start security training programs.

1988

About 45 million PCs are in use in the United States.

Apple files a copyright infringement (of the Macintosh operating system) lawsuit against Microsoft for Windows 2.03 and Hewlett-Packard for *New Wave* (a graphical interface kit).

Microsoft introduces *PC Works* and *OS/2 LAN Manager* for networked PCs and *Microsoft Publisher*, a desktop publishing program for novice users.

The installed base for MS-DOS is approximately 29,550,000.

1989

Tim Berners-Lee proposes a way to let scientists browse each other's papers to the European Particle Physics Laboratory (CERN). The language and protocol he develops leads to the creation of the World Wide Web.

Creative Labs introduces SoundBlaster, a sound card for the PC that contains an 11-voice FM synthesizer with text-to-speech, digitized voice input/output, a MIDI port, a joystick port, and bundled software.

GRiD Systems Corp. announces the GRiDPAD, the first pen-based computer.

More than 100 million computers are in use worldwide.

Intel releases the 486DX processor, with more than 1 million transistors and multitasking capabilities.

Hayes announces an enhancement of the AT command set for modems to accommodate ISDN (Integrated Services Digital Network) technology.

Quarterdeck is granted a patent for creating a way to display more than one DOS application on-screen inside Windows.

Poqet announces the Poqet PC, the first pocket-sized MS-DOS-compatible computer.

1990

Microsoft releases Windows 3.0, a complete rewrite of previous versions and one in which most desktop users will eventually spend most of their time. Windows 3.0 uses a graphical user interface (GUI), and Microsoft sells more than 3 million copies of Windows 3.0 in one year.

Microsoft exceeds $1 billion in sales in a single year, the first computer-related company to do so.

Microsoft releases its first product for the Russian market, Russian DOS 4.01.

The World, the first commercial provider of Internet dial-up access, comes online.

Creative Labs introduces the SoundBlaster Pro. The 8-bit stereo sound system, which includes a CD-ROM interface, a joystick port, and stereo recording, is accepted as the standard for multimedia PCs. SoundBlaster becomes the best-selling add-on board for the personal computer market.

Quarterdeck releases its memory management software, *QEMM386* version 5.1. It becomes the fastest-selling software program in the United States.

The Multimedia Personal Computer (MPC) standards are developed by Tandy and Microsoft. These standards denote the specifications a computer needs to be considered capable of running multimedia software.

Microsoft and IBM stop working together to develop operating systems.

The first issue of *PC Novice* is published.

1991

Gopher, a menu-driven, search-and-retrieval tool that helps Internet users locate information online, is developed at the University of Minnesota.

In an effort to bring lower-cost 486 performance to the mainstream user, Intel introduces the 486SX chip. The chip performs at 20 megahertz (MHz) and sells for $258.

The World Wide Web is launched. Tim Berners-Lee, a scientist at the European Particle Physics Laboratory (CERN) in Geneva, Switzerland develops the Web as a research tool.

Following its decision not to develop operating systems cooperatively with IBM, Microsoft changes the name of OS/2 to Windows NT.

Although IBM had expected to sell a maximum of 250,000 personal computers, sales surpass 60 million units in the business market. However, the year marks the company's first revenue decline in almost half a century.

Logitech ships its 10 millionth mouse.

Although the GRiD Systems Corp.'s GRiDPAD and MicroSlate Inc.'s Datellite 300 are the only two computers currently available that recognize handwriting and allow data to be input using a special pen, the push for handwriting recognition gains momentum as 30 companies announce plans to develop similar computers.

Creative Labs releases a multimedia upgrade kit that includes a CD-ROM drive, the SoundBlaster Pro sound card, a MIDI kit, and a variety of software applications. The kit includes all the tools needed to meet the MPC standards.

Sony, Philips, and Microsoft introduce CD-ROM extended architecture, which makes it possible for text and video to be narrated in CD-ROM software.

1992

Bill Gates is now the second richest man in the United States, with a net worth estimated at more than $4 billion.

Microsoft introduces Windows 3.1. It sells more than 1 million copies within the first two months of its release.

The number of host computers on the Internet passes the 1 million mark.

Microsoft and IBM agree to sever all ties that connect the two companies but sign a separation document that allows source-code sharing for current operating systems until September 1993.

Intel releases the 486DX2 chip with a clock-doubling ability that generates a higher operating speed.

Radio Shack releases the Tandy Sensation! MPC, the first personal computer based upon the MPC specification.

1993

Fifty World Wide Web servers are known to exist as of January.

President Bill Clinton puts the White House online with a World Wide Web page and E-mail addresses for the president, vice president, and first lady.

Microsoft releases Windows NT, *Microsoft Office* 4.0, and MS-DOS 6.0, which includes the ill-fated DoubleSpace compression utility. Stac Electronics later sues Microsoft for patent infringement in regards to the DoubleSpace utility. In subsequent versions of MS-DOS, Microsoft removes the utility and eventually replaces it with Drive-Space.

Intel releases the Pentium processor. This 60 megahertz (MHz) processor incorporates 3.2 million transistors and sells for $878.

Gateway 2000 sells its millionth computer.

Microsoft releases Windows NT 3.1, Windows for Workgroups 3.11, and MS-DOS 6.2.

Mosaic, the first graphical Web browser, is released by the NCSA (National Center for Supercomputing Applications) at the University of Illinois.

John Scully is named president of Apple Computers Inc. Scully is best known for encouraging Apple to invent and sell a palmtop computer called the Newton.

The Internet experiences massive growth. The World Wide Web grows 341,634%; Gopher grows at a rate of 997%.

IBM announces a year-end loss of $8.1 billion.

The Environmental Protection Agency, along with 50 computer companies, establishes Energy Star guidelines, which aim to decrease the amount of power that PCs use when they're idle.

1994

Marc Andreessen and James H. Clark found Netscape Communications and release *Netscape Navigator* browser software, which provides an easy, point-and-click method of navigating the Internet.

Commodore Computers, which sold the famous Commodore 64 personal computer, files bankruptcy.

The Internet celebrates its 25th anniversary.

Microsoft purchases Softimage Inc., a Montreal-based supplier of Hollywood special effects tools, for $130 million in stock. Softimage Inc.'s tools were involved in creating the special effects for "Jurassic Park" and other films.

After Stac Electronics successfully sues Microsoft for patent infringement in regards to the DoubleSpace utility included in MS-DOS 6.0 and 6.2, Microsoft releases MS-DOS 6.21, which has no disk compression utility. Later that year, Microsoft releases MS-DOS 6.22 with the DriveSpace disk compression utility.

Microsoft, Hewlett-Packard, US West, Telstra, Deutsche Telekom, NTT, Olivetti, Anderson, and Alcatel join forces in an effort to develop the hardware and software necessary for the actualization of interactive television.

Microsoft and Visa International enter an agreement whereby Microsoft will develop software that will allow for electronic shopping.

IBM releases OS/2 Warp 3.0. It will sell 4 million copies during the next year.

Microsoft releases the beta version of its new operating system, mysteriously referred to only as "Chicago." Chicago will later be released as Windows 95.

Because of questions regarding potential antitrust violations surrounding the distribution of its operating systems, Microsoft signs a consent agreement with the U.S. Department of Justice and the European Union to cease its discounting practices related to MS-DOS and Windows.

1995

Apple finally allows other companies to clone the Macintosh computer.

Hewlett-Packard, Borland, Dell, and Lotus are among 50 companies in the PC industry who agree to sell and service their products over The Microsoft Network.

Microsoft releases *Microsoft Bob*, a graphical user interface designed for the home user. In the first sixth months, a mere 30,000 units are sold.

Following the formation of DreamWorks SKG, the new entertainment studio headed by Hollywood moguls Steven Spielberg, Jeffrey Katzenberg, and David Geffen, Microsoft announces that it has formed a joint venture with the company. This new joint-venture software company, called DreamWorks Interactive, will develop and create entertainment multimedia software for home consumers.

A number of Internet-related companies go public. Netscape has the most successful initial public offering (IPO), opening at $28 per share and closing at $58 per share. By the day's end, the company, which gave away its Web browser and never made a profit, had increased its worth to $2.2 billion. This was the third-largest NASDAQ IPO share value ever.

Microsoft and General Electric's NBC television network form a partnership to develop interactive television programs.

After Microsoft announced its intentions to purchase Intuit, the U.S. Department of Justice files suit to stop Microsoft. As a result, Microsoft withdraws its offer.

Microsoft releases Windows 95 (Win95), *Microsoft Office* 95 and the online Microsoft Network. More than 1 million copies of Win95 are sold in the first four days of its release.

Operation Home Front allows U.S. soldiers in the field to communicate via the Internet with stateside family members.

Intuit, the maker of the financial software *Quicken*, announces that it is working with 19 financial institutions, including American Express, Chase Manhattan Bank, and Wells Fargo, to develop an online link that will let customers with modems dial into their accounts.

Although it costs Intel nearly $475 million to do so, the processor manufacturer destroys 1.5 million mathematically flawed Pentium chips.

A New York judge rules that Prodigy Services Co. is responsible for the content of a libelous message posted by a subscriber. Because Prodigy claimed it tried to censor some obscene material, the court ruled that the online service was responsible for all material posted.

1996

Intel releases the 200 megahertz (MHz) P6, or Pentium Pro, chip, which is the next generation of processors.

IBM and Sears sell the Prodigy online service to a group of investors called Internet Wireless.

AT&T introduces Worldnet, which provides AT&T customers in certain cities with Internet access and five free hours of use each month.

The IBM computer Deep Blue beats chess master Garry Kasparov in two chess matches (although Kasparov went on to win the series). Deep Blue proved that computers may be able to come close to "thinking" and helping humans solve complex problems in many industries.

"Java" and "telephony" are the buzzwords on the Internet. Java allows small applications, called applets, to be run on Web sites, expanding the capabilities of the World Wide Web. Telephony lets users talk to each other over the Internet without paying long-distance telephone charges.

The America's Carriers Telecommunication Association (ACTA), acting on behalf of U.S. regional long-distance carriers, asks the FCC to subject Internet telephony to the same access charges that other long-distance carriers pay.

Intel announces that the MMX processor will be released in 1997. The processor will incorporate a video accelerator into the chip itself.

Bill Gates has a net worth of $18 billion, which makes him the richest man in the United States.

In a deal valued at about $300 million, NEC Corp., the largest seller of PCs in Japan, merges its PC operations outside Japan with Packard Bell, the No. 2 worldwide seller of PCs in 1995.

NBC and Microsoft offer intercasting just in time for the 1996 Summer Olympics. Intercasting combines the flexibility of the Internet with the programming content of television to create an interactive viewing experience.

The Summer Olympics in Atlanta, Ga., uses technology provided by IBM, including 7,000 PCs, 2,000 pagers and wireless devices, and 90 industrial-strength computers. The IBM network is used by approximately 150,000 athletes, coaches, journalists, and Olympic staff members.

Sony enters the PC market with the release of VAIO, a multimedia computer aimed at the home-entertainment market.

President Clinton signs into law the Communications Decency Act (CDA) as part of the Telecommunications Bill, which bans the diffusion of obscene materials on the Internet.

After German officials claim that 200 of CompuServe's online newsgroups violate German obscenity laws, CompuServe incorporates

parental control tools into its interface and restores access to the 200 banned newsgroups.

The ENIAC, considered by some the world's first general-purpose computer, celebrates its 50th anniversary.

Creative Labs, a leader in the sound card market, enters the graphics card market with its 3D Blaster card, which enhances current three-dimensional graphics. This occurs mostly in games but also in other areas, such as enhancing the images on World Wide Web pages.

The game *Oregon Trail*, which was one of the first edutainment programs, celebrates its 25th anniversary.

A prototype of the Personal Area Network (PAN) is introduced by IBM. The PAN is a small computer on a card that sends data through a stream of electric signals throughout a person's body. The body acts as a conductor that lets data travel to and from devices such as pagers, handheld computers, and cellular phones.

Exponential Technology announces it will release the X-704 chip, a microprocessor that can run Apple Macintosh software at up to 533 megahertz (MHz). Each chip will cost $1,000.

Apple stock sinks to a 10-year low of less than $18 after reporting a 26% loss in sales in May.

In Massachusetts, speeding tickets and car registration renewals can be done online via the Registry of Motor Vehicles World Wide Web site. Several other states are experimenting with the online registry, as well.

Several handheld computers are announced, such as the Pilot from U.S. Robotics, the eMate from Apple Computer Inc., and the MessagePad, also from Apple.

Microsoft releases Windows CE, its operating system for handheld computers.

The Supreme Court rules that the Communications Decency Act is unconstitutional because it violates free-speech rights. The act was supposed to prohibit the transmission of "patently offensive" material to children through the Internet. Violating this act was to have been punishable by up to two years in prison and a $250,000 fine.

Tandy Corp. announces it is either selling or closing all of its 17 Incredible Universe stores and 19 of its Computer City stores because of low consumer electronic sales and losses in revenue.

The Intel supercomputer, which has the primary purpose of simulating nuclear weapons testing, does 6.4 quadrillion mathematical calculations in one hour and 20 minutes, or 1 trillion calculations per second, using 7,264 Intel Pentium processors strung together. The supercom-puter is priced at $55 million.

WebTV, which is a device that can be used to surf the World Wide Web when hooked into a telephone line and a television, is introduced. WebTV is manufactured by Sony and Philips Magnavox and retails for less than $300.

America Online is the largest online service with 6.5 million members. CompuServe is second with 4.5 million users, and The Microsoft Network is third with 1.6 million.

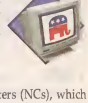
Residents of California, New York, Ontario, and Quebec are able to list their E-mail addresses and Web page addresses in the telephone book.

MSNBC, a new cable channel combining The Microsoft Network's Web site and NBC News, makes its debut. On its third day of service, MSNBC's first breaking story, the TWA Flight 800 disaster, competes directly with CNN.

Acer America Corp. introduces designer home PCs in charcoal and dark green colors instead of the standard beige.

The Federal Communications Commission (FCC) approves high-tech specifications for digital television, which will bring CD-quality sound and sharper images in a format called high definition to home TV sets.

Approximately 925 freshmen at Wake Forest University receive IBM ThinkPads, which are portable computers, to use for taking notes, studying, and doing homework. These computers are used extensively on campus and belong to the university until the students receive them at graduation.



The Republican National Convention is watched by many all over the world via the Internet.

Sun Microsystems releases its line of network computers (NCs), which are devices that do much of what a PC does and are meant to be used in a corporate setting. NCs are attractive to companies because they are much cheaper than PCs and receive most of their information from a centralized network.

There are presently 2 million PCs used by the federal government and 2.8 million PCs used by state and local governments in the United States.

Apple buys NeXT Software Inc. for $400 million and acquires Steve Jobs, Apple's co-founder, as a consultant.

Road Runner, a new online service by Time Warner Inc., makes its debut. It uses a pre-existing cable TV system to provide faster connections.

Compaq holds the No. 1 spot as the world's leading seller of personal computers for the third consecutive year.

1997

Intel launches the MMX chip, which is a multimedia upgrade of the Pentium processor. Intel expects the MMX chip to improve the performance of a Pentium-run computer about 10% to 20% on average and up to 60% with programs written specifically for the chip.

Several computer manufacturers, such as Compaq, Packard Bell, NEC, and Apple introduce computers costing less than $1,000 with the hopes of selling more home systems.

A 67Kbps modem is released by Transend for about $600, which is more than twice the price

of most modems. This new modem uses two phone lines simultaneously and promises the same speed for both sending and receiving.

America Online (AOL) faces several lawsuits from subscribers who are upset about the difficulties encountered when trying to log on to the service. In response, AOL stops advertising in order to cut down on its capacity overload and offers refunds on a case-by-case basis. The overload is because of the flat rate of $19.95 per month that AOL offers users for unlimited access.

Apple Computer Inc. introduces the PowerBook 3400, the fastest laptop computer available, with a 240 megahertz (MHz) processor. The PowerBook 3400 retails for $6,500.

IBM's Deep Blue computer defeats world-champion chess player Garry Kasparov in their second six-game showdown, winning the tie-breaking game in only 62 minutes.

Cyrix Corp. releases its 6x86MX processor and claims it will give the same performance as the Pentium II processor. However, a system with Cyrix's chip sells for less than $2,000, while a system containing the Pentium II chip costs more than $2,500.

Digital video discs (DVDs) go on sale. They look exactly like music CDs or CD-ROMs but hold more data, such as full-length movies such as "The Wizard of Oz."

Microsoft announces that it will no longer make the Windows NT operating system (OS) for the Macintosh platform. This OS is based upon the PowerPC chip, which is an alternative to the Intel Corp. chips found in most personal computers. Microsoft will continue to make Windows NT for Digital Equipment Corp. and Intel chips.

Microsoft Corp. buys WebTV Networks for $425 million.

CompUSA joins Dell and Gateway in selling build-to-order PCs.

Bill Gates, chief executive officer of Microsoft, is the world's richest businessman, according to *Forbes* magazine. His estimated worth is $36.4 billion.

Intel sues Digital Equipment Corp. for patent infringement on technology used to make the Pentium, Pentium Pro, and Pentium II processor chips. Digital countersues because Intel refuses to present confidential documents that the company had given Digital to assist in designing computer products.

PC Novice magazine changes its name to *Smart Computing*.

The NASA Pathfinder Web site, which is running real-time images sent from the Pathfinder on Mars, receives more than 100 million hits during its first four days, a new popularity record that forces NASA to set up 25 mirror pages to handle the user traffic.

Seven new endings for Internet addresses are approved. These endings are .STORE for businesses offering goods, .INFO for information services, .FIRM for businesses or firms, .REC for recreational, .NOM for personal sites, .ARTS for cultural groups, and .WEB for sites emphasizing the World Wide Web.

Microsoft is working on its own search engine, code-named "Yukon," for the Internet and hopes to release a final version at the beginning of 1998.

Microsoft, with the help of Toshiba, invites 50 school districts to participate in "Make Vision A Reality," a program in which students use laptop computers to take notes, study, and do homework.

The U.S. Senate approves the removal of computer games from government computers. The government isn't allowed to purchase new computers with preinstalled games.

Microsoft releases *Microsoft Office* 97 and announces that its new operating system, Windows 98, will be released in the spring of 1998.

3Com buys $6.6 billion in U.S. Robotics stock, making the consolidation the largest in the history of computer companies.

Apple Computer Inc. introduces Mac OS 8, a new version of the Macintosh operating system.

The U.S. Postal Service looks at a plan to create electronic stamps for letters and packages.

U.S. students in kindergarten through the 12th grade have access to 6.3 million computers with a ratio of 7.3 students per computer.

A security flaw is discovered in the *Microsoft Internet Explorer* Web browser that allows a "Webmaster" to have access to files and programs on someone else's computer.

A Nielsen survey is released showing that almost one in four (23%) adults use the Internet with 42% of those being women, which is up from 10% five years ago.

Corporations and companies with computer networks are searching for the answer to the year 2000 glitch. This is a problem because a lot of computer software will malfunction when the millennium changes because the software uses the last two digits of a year and won't be able to understand that the dates are for a new century.

The president and chief executive officer of CompuServe, the second largest online service in the United States, resign.

United Airlines begins to install power ports for portable computers on its planes that make major international or long-range flights.

Microsoft invests $150 million in Apple Computer Inc. shortly after CEO Gil Amelio is ousted. Microsoft agrees to continue making software in Macintosh format, and Apple agrees to make *Microsoft Internet Explorer* the browser choice for Macintosh computers.

The Bandai Company has trouble keeping the Tamagotch, or "cute little egg," on store shelves. The Tamagotch is a keychain computer game in which the user must take care of it as though it were a small pet by feeding it, playing with it, and disciplining it.

1998

Compaq Computer Corp. purchases Digital Equipment Corp. for $9 billion.

Microsoft invites average computer users to join its Consumer Beta Preview Program for its upcoming operating system, Windows 98, for about $30 per trial kit.

A Market Intelligence report cites the number of U.S. households that own at least one personal computer rose by 11.4% since 1997. By January 1998, more than 45 million households, or 44.8% of the total number of U.S. households, owns a personal computer, compared with the 1997 percentage of 40.7.

Hearings open between Microsoft and the U.S. Department of Justice concerning whether or not Microsoft has a monopoly on the software market because PC manufacturers, due to agreements with the giant software company, automatically include Windows 95 (and later Windows 98) and Microsoft Internet Explorer on nearly every PC made.

Netscape, in a rush to outdo its competitor Microsoft, announces its Navigator 5.0 and Communicator 5.0 products will be free. Even more newsworthy, however, Netscape reveals the source code for Navigator on its Web site.

Reports say "Internet addiction" is a growing problem on college campuses. Several studies, including one from the University of Michigan, says freshman and sophomore undergraduates spend an average of 10 hours per week online. To counter this, some universities enact programs to keep students offline.

Twenty-seven states collude with the Department of Justice in the antitrust lawsuit against Microsoft Corp.

A demonstration version of Windows 98 crashes on Bill Gates at Comdex (a computer industry-wide hardware and software trade show) in Chicago. During the presentation of the new operating system, Windows 98 went down when one of Gates' assistants attempted to install a scanner.

NASA commands all scientists to withhold reports of "killer asteroids" for at least 72 hours after discovery. NASA's action stands to avoid the mass hysteria that could result if such information were to be spread over the Internet.

Cybercolumnist Matt Drudge "scoops" Newsweek with the first news of President Clinton's sexual indiscretions with a White House intern, Monica Lewinsky. Such fast action prompts media outlets around the world to question the credibility of news that is posted on the Internet.

Koko, the 26-year-old, 300-pound gorilla renown for her mastery of American Sign Language and ability to recognize nearly 2,000 words of spoken English, went online for the first "interspecies online chat," sponsored by America Online and Envirolink. Lasting for 45 minutes, Koko signed her answers to nearly 8,000 users' questions, which went to a translator who then typed in Koko's responses.

Windows 98 is officially released by Microsoft on June 25.

In an attempt to help consumers keep up with the technology curve, Gateway introduces its Your:)Ware program. With this program (and its stipulations), users can trade in their computer and get a credit toward a new Gateway machine every two to four years.

Apple introduces the iMac, an aqua-blue futuristic-looking computer that is without a 3.5-inch 1.4MB diskette drive. Apple contends the diskette drive is on its way to extinction, saying most files are either saved on media with much larger storage spaces, such as CD-ROMs, or are transferred via E-mail. However, most other computer systems still ship with the drive installed.

1999

Apple follows up its phenomenally successful iMac with the PowerMac G3 in a bold bid for desktop dominance. This Macintosh features PC-type components, such as PC-100 memory and PCI slots, to take advantage of the existing performance-upgrade market. Its minitower case sports removable translucent panels and molded plastic handles at the corners.

CPU manufacturer AMD (Advanced Micro Devices Inc.) surpasses Intel in market share for the first time. A January report indicates 43.9% of new computers sold were powered by AMD chips, compared to 40.3% with Intel CPUs.

The stunning success of eBay illustrates the booming growth of online auction sites. These seek to provide a reasonably secure forum for online users to buy and sell almost anything. In March, online bookseller Amazon.com launches its own auction service.

Intel's newest CPU model, the Pentium III, draws fire from privacy groups. Each PIII chip is encoded with a unique serial number, which can potentially be used to track the computer's usage if revealed to other computers. After a storm of protests, Intel announces users can enable or disable the feature through software, and that it will be turned off by default.

Vice President Al Gore, in a March interview on CNN, apparently takes credit for today's online world. "During my service in the United States Congress," Gore said, "I took the initiative in creating the Internet." His long-time enthusiasm for interconnected computing is suddenly overshadowed by a deluge of late-night monologue jokes.

The world's richest man, Microsoft CEO Bill Gates, holds a net worth of at least $76 billion by the end of the first quarter of 1999. Often quoted as saying he plans to give away all his wealth in his lifetime, Gates' donations to his charitable foundations rival the revenue streams of entire corporations.

The Dow Jones Industrial Average tops 11,000 for the first time, led by the Internet explosion and stocks such as America Online, Yahoo!, and Microsoft. In particular, eBay's stock price reaches a whopping high of $234 after going public at $18 just seven months earlier.

Shortly after NATO begins its bombing of Serb forces in Kosovo, hackers worldwide begin attacking its computer systems. Hackers also attacked the sites of the U.S. Navy, the Pentagon, the Department of Defense, the Department of Energy, the Department of the Interior, the National Park Service, and the White House.

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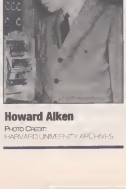
Who's Who In Computing

Throughout history, there were many people who were involved in the evolution of computers. On the following pages, we've tried to include a sampling of those persons who have been recognized as making major contributions to the computing world. Where possible, we've also included photos, birth, and death dates.

When dealing with historical data in a fast-moving field such as technology, pinpointing who actually did what can be difficult. Often, technical advances are made by groups of people, but credit may be given to (or taken by) a specific individual. In other cases, two or more people may have made essentially the same discovery at the same time, but only one person received historical recognition for it. While compiling these biographies, we ran into several situations with conflicting information provided by various sources. As much as possible, we tried to corroborate the data and give credit where it is due.

Aiken, Howard Hathaway (1900-1973)

During World War II, Harvard mathematician Howard Aiken essentially created Charles Babbage's dream machine with the help of the U.S. Navy and IBM. The Harvard-IBM MARK I, a program-controlled, large-scale calculating machine completed in 1944. The machine was noted for its reliability and accuracy, and it did calculations full-time during the war. Later versions improved accuracy and ease of use, and the MARK IV was the first machine to use an internally stored program. Although Aiken credited IBM engineers B. M. Durfee, Frank E. Hamilton, and Clair D. Lake as co-inventors, Aiken is considered the driving force behind the projects, and his work influenced future mathematicians and the design of future machines. Aiken also recognized the importance of having future mathematicians program computers, and he convinced Harvard to establish graduate degrees in what would become computer science.



Howard Aiken
PHOTO CREDIT: HARVARD UNIVERSITY ARCHIVES

Allen, Paul G. (1953-)

Seattle native who, in cooperation with Bill Gates, wrote a form of BASIC-for the MITS (Micro Instrumentation and Telemetry Systems) Altair. During the 1980s, IBM hired Allen and Gates to create an operating system (OS) for a new PC. The pair purchased the rights to a simple operating system (manufactured by Seattle Computer Products) and used it as a template. In a decision with monumental repercussions for the computer industry, IBM chose to market the operating system under its own name while letting another company known asMicrosoft (which was started by Allen and Gates), retain the rights to market the OS under its own name also. These new operating systems, known as MS-DOS and PC DOS, soon became the most popular operating systems in the PC market. Microsoft eventually became the largest software company in the world. Allen left the company in 1985, but remains on the board of directors and has founded or financially supported several innovative computer ventures, including Asymetrix Learning Systems, Inc., and Vulcan Ventures Inc. Allen has established six Allen Charitable Foundations, which support arts, medical, forest protection, and other charitable needs in the Pacific Northwest. He is the founder of the Experience Music Project in Seattle and Clear Blue Sky Productions in Bellevue.

Paul Allen

Amdahl, Gene M. (1922-)

South Dakota native who helped design the IBM 704, the S/360 series, and other devices that bear his name. He founded Amdahl Corp., the largest manufacturer of IBM-compatibles during the 1970s, and also formed Trilogy.

Gene Amdahl
PHOTO CREDIT: AMDAHL CORP.

Andreessen, Marc (1971-)

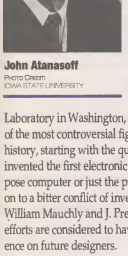
At the age of 22, Marc Andreesen was a co-founder of Netscape Communications, along with Silicon Graphics founder James H. Clark. Before Andreessen graduated from the University of Illinois in Champaign, he had

created the NCSA Mosaic Web browser prototype with a team of students and staff at the university's National Center for Supercomputing Applications. The product offered a friendly, point-and-click method for navigating the Internet. Netscape released its Netscape browser software in 1994, and by some estimates, nearly half of all Web browsing is done with Andreessen's Netscape Navigator.

Marc Andreessen
PHOTO CREDIT: NETSCAPE

Atanasoff, John Vincent (1904-1995)

Physics professor at Iowa State College (now Iowa State University) who designed, but never completed, one of the first machines to use electronic techniques in digital calculation. He is often considered the father of the modern computer, but he was not recognized until recently and never received money for his contributions. In 1939, he and a graduate student, Clifford Berry, had a working prototype of the binary-based ABC (Atanasoff-Berry Computer), but the machine was abandoned when Atanasoff went to work for the Naval Ordnance Laboratory in Washington, D.C. Atanasoff is one of the most controversial figures in computer history, starting with the question of whether he invented the first electronic digital special-purpose computer or just the pieces of it and going on to a bitter conflict of invention with John William Mauchly and J. Presper Eckert. His efforts are considered to have had a great influence on future designers.



John Atanasoff
PHOTO CREDIT: IOWA STATE UNIVERSITY

Babbage, Charles (1791-1871)

Eccentric, irascible English mathematician who is generally considered to have conceptualized the modern computer a century before technology let it be built. He conceptualized the Difference Engine, a machine that would have computed lengthy scientific tables, but money, labor, and health problems prevented its completion (although some have said it was never finished simply because Babbage kept tinkering with it). The Analytical Engine, a more ambitious plan, would have performed a wide range of calculating tasks. With it, Babbage recognized the need for an input device, memory, a central processing unit, and an output device. For this he is sometimes known as the "Father of Computing." His social set included naturalist Charles Darwin, novelist Charles Dickens, and poet Henry Wadsworth Longfellow, and he also invented (among other notable things) a sail-powered train, the standard railroad gauge, uniform postal rates, the first air conditioning in London (for his house), the speedometer, and the cow-catcher for locomotives. In his spare time, he waged war against street musicians, particularly organ grinders, who eventually went out of their way to serenade him, even as he lay on his deathbed.

Charles Babbage
PHOTO CREDIT: CHARLES BABBAGE INSTITUTE, UNIVERSITY OF MINNESOTA, MINNEAPOLIS

Backus, John W. (1924-)

Mathematician from Philadelphia who headed the research team at IBM that created FORTRAN, the first machine-independent programming language that could be used on more than one computer. This language gave programmers a quicker, cheaper, and more reliable way of programming and became a standard.

Baldwin, Frank Stephen (1838-1925)

Created the first properly-constructed variable-toothed gear in about 1875 in the United States at the same time Willgodt Odhner was making a similar one in Europe. The gear, which was reliable, small, and easy to use, resulted in a breakthrough in the calculating machine industry. Baldwin patented a mechanical calculation machine in 1873 and went into business with Jay Randolph Monroe. Unfortunately for Baldwin, the machines produced beginning in 1911 became known as Monroe calculators.

Bardeen, John (1908-1991)

Wisconsin-born co-inventor of the transresistor, or transistor, and a member of the AT&T Bell Telephone Laboratories team along with Walter Brattain and William Shockley. The transistor they invented had the same capabilities as a vacuum tube but was faster, broke less often, and used less power. The three received a Nobel Prize in physics in 1956, and Bardeen went on to share another for research on superconductivity at low temperatures, making him the only scientist to receive two Nobel Prizes in the same field.

John Bardeen
PHOTO CREDIT: AT&T ARCHIVES REPRINTED WITH PERMISSION OF AT&T

Bartik, Jean (1935-)

Missouri-born math prodigy recruited in 1945 to join a University of Pennsylvania team of young women who calculated trajectories to help wartime artillery gunners aim their weapons. The Army called Bartik and the other women "computers" because of their complex work. Bartik was later one of the programmers of the Electronic Numerical Integrator And Calculator, known as the ENIAC. The device is known as one of the first electronic, large-scale, general-purpose computers. Bartik and her cohorts had the task of breaking down complex differential equations into the smallest steps possible, making sure that each was routed to the right place and performed in the correct order. After the Army's unveiling of the ENIAC, Bartik began working with Adele Goldstine, revamping it to be a stored program computer. Though they worked closely with the great mathematician John von Neumann, it was Bartik who wrote the code.

Bell, Gordon (1934-)

Missouri-born engineer who made influential innovations in the design of everything from small computers to multiprocessors. The open bus structure and general registers for memory addressing were among the innovations. Bell worked for Digital Equipment Corp. (DEC), where he designed the company's first mini and time-sharing computers. He later founded

Encore Computing, worked for the National Science Foundation, founded The Computer Museum in Boston with his wife, Gwen, and focused his efforts on the necessity of video telephony. Bell is now a senior researcher in Microsoft's Telepresence Research Group.

Berners-Lee, Tim (1956 -)

British Oxford graduate who is essentially the father of the World Wide Web (WWW). While working for European Particle Physics Laboratory (CERN) in Geneva, he proposed a method that would let scientists browse each other's papers. For the project, he created a code known as the Hypertext Markup Language (HTML) and a standard called Hypertext Transfer Protocol (HTTP), with a universal resource locator (URL) that could locate data. Berners-Lee is now the director of an organization that aims to let the Web realize its full potential and ensure its stability as it rapidly evolves. This organization is known as the World Wide Web Consortium (W3C).

Tim Berners-Lee

Berry, Clifford Edward (1918-1963)

New York-born graduate student at Iowa State College (now Iowa State University) who, along with John Atanasoff, designed but did not complete one of the first machines to use electronic techniques in digital calculation. This machine would have been the world's first electronic digital computer. Berry and Atanasoff had a working prototype of the binary-based ABC (Atanasoff-Berry Computer) in 1939, but the machine was abandoned during World War II. Although Atanasoff is generally credited with the machine's concept, Berry is said to have done an equivalent amount of work on the actual design and construction.

Clifford Berry
PHOTO CREDIT:
IOWA STATE UNIVERSITY

Bezos, Jeffrey P. (1965 -)

A Princeton electrical-engineering graduate who—after becoming the youngest vice president for both the Bankers Trust Company and D. E. Shaw and Co.—emerged as one of the world's first entrepreneurs in electronic commerce. Bezos was looking for something to market over the Internet and eventually decided on books. He founded Amazon.com, an online book retailer that calls itself the world's largest bookstore. Amazon is now considered one of the standout success stories on the Internet and has been branching out its operations into music, movies, and auctions. Bezos has profited handsomely from Amazon.com's success, and has joined the growing list of high-tech billionaires.

Billings, John Shaw (1838-1913)

Physician and high-ranking U.S. Census Office official credited with giving Herman Hollerith the idea for a machine that would use cards to tabulate statistics. Where or how Billings got the idea is debated.

Boole, George (1815-1864)

Self-taught British mathematician who gave scientific respectability to Gottfried Leibniz's idea that 1 and 0 could express all mathematical ideas, thus laying the foundation for modern higher algebra. Boole proposed a form of logic (now known as Boolean algebra) using two digits: 1 to represent something and 0 to represent nothing or the lack of something. This idea—and the ability to place logic underneath mathematics in the form of true and false statements—was instrumental in the development of circuitry, computation, and digital computers.

Booth, Andrew Donald

British engineer and physicist who was an early proponent of magnetic drum memories for computers. By 1952, he and his father were selling fairly reliable working drums made from brass cylinders plated with nickel. Booth also experimented with thermal memory and tried to construct a "floppy" disk with oxide-coated paper.

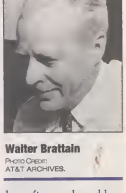
Brainerd, Paul (1947-)

Former Minnesota newspaperman, who grew up in Oregon, was the founder of the Aldus Corp., the company that popularized desktop publishing (a term that Brainerd himself coined). His revolutionary program, Aldus PageMaker, let users change and view type styles without typing tedious codes and combine and manipulate text and imported graphics on a page. All of this could be done with a low-cost computer and laser printer. Brainerd sold Aldus in 1994 and founded the Brainerd Foundation, which is dedicated to protecting the environment in the Pacific Northwest.

Paul Brainerd
PHOTO CREDIT:
KEVIN LATONA

Brattain, Walter (1902-1987)

China-born American who co-invented the transresistor, or transistor, and was a member of the AT&T Bell Telephone Laboratories team with John Bardeen and William Shockley. The transistor they invented had the same capabilities as a vacuum tube but was faster, broke less often, and used less power. The three shared a Nobel Prize in physics in 1956.



Walter Brattain
PHOTO CREDIT:
AT&T ARCHIVES.

Bricklin, Dan (1951-)

Man who conceived and designed the first electronic spreadsheet, VisiCalc, which was released in 1979. Bricklin designed the interface, and his partner, Bob Frankston, wrote the code. The program—which was introduced on the Apple II—gave people without computer science degrees a reason to buy a home computer. The rights to VisiCalc eventually ended up in the hands of Lotus Corp. in 1985.

Briggs, Henry (1561-1631)

English mathematician who spread the use of logarithms and created a modified, easier-to-use version now known as base 10. Briggs produced amazingly accurate logarithm charts.

Burgi, Jobst (1552-1632)

Swedish mathematician who is often considered to have independently invented logarithms at the same time as John Napier.

Burroughs, William S. (1857-1898)

New York-born inventor who, after working in a bank, was so appalled by the inaccuracies of hand accounting that he created and patented a printing adding machine in 1888. With the financial support of some St. Louis businessmen, he created the American Arithmometer Company. Either because the 50 machines he made didn't sell or didn't meet his standards, he dropped them out a two-story window, one by one, in 1889, but a redesigned version he patented the next year was an astonishing success. By 1913, years after he died from tuberculosis, his company dominated the office equipment market.

William Burroughs
PHOTO CREDIT: CHARLES BABBAGE INSTITUTE, UNIVERSITY OF MINNESOTA, MINNEAPOLIS

Bush, Vannevar E. (1890-1974)

Massachusetts-born engineer and politician who created the mechanical differential analyzer, the first serious attempt to design a computer that could do many kinds of scientific computations and the herald of the modern computer age. He also introduced the idea of hypertext in the article "As We May Think," published in 1945 . Bush created the National Defense Research Committee in 1940 to organize scientists and engineers for World War II, and his leadership (of up to two-thirds of U.S. physicists) was instrumental in the Manhattan Project.

Byron, Augusta Ada (1815-1852)

See King, Augusta Ada.

Case, Steve (1959 -)

Co-founder, president, and CEO of America Online Inc., the world's largest consumer-based online service. Case, after graduating with a political science degree from Williams College and dabbling with marketing at PepsiCo and Procter & Gamble, began kicking around the idea of a mass-market consumer online service. In 1985, Case began America Online (AOL) as a simple dial-up service for Quantum computer users. By the mid-1990s, AOL's easy-to-use interface had helped it become the fastest growing online service, and Case's marketing strategy of blanketing the universe with startup diskettes made its name a household word. In the late 1990s AOL purchased arch rival CompuServe, and in the summer of 1998 announced it had surpassed 13 million members.

Steve Case
PHOTO CREDIT: AMERICA ONLINE

Cerf, Vinton G. (1943-)

Born in New Haven, Conn., the "Father of the Internet" co-developed the TCP/IP (Transmission Control Protocol/Internet Protocol) networking protocol, which is the language governing communication between all computers on the Internet. From 1976 to 1982, Cerf also played a major role in developing networking packet technologies for the Advanced Research Projects Agency (ARPA) at the U.S. Department of Defense. The UCLA Ph.D. graduate is now senior vice president of data architecture for MCI's Data and Information Services Division.

Vinton Cerf
PHOTO CREDIT: MCI

Clement, Joseph (1779-1884)

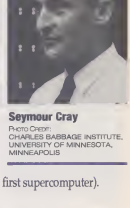
English mechanic who was hired by Charles Babbage as the chief mechanic for the Difference Engine. Clement seemed to play a significant role in its design, and depending upon whose story you hear, he was either undercredited or a scoundrel. When the two argued about payment and the working conditions of a new fireproof building, Clement took the drawings (which he later returned) and tools he had built (which he was legally entitled to have) and walked off the job. He later attempted to come to a settlement, but Babbage refused to meet his demands.

Comrie, Leslie John (1893-1950)

Scientist who was among the first to use business calculating machines for scientific purposes. Comrie, head of the National Almanac Office in London, used the Burroughs machine to calculate and print astronomical tables and also adapted the Hollerith machine to do scientific calculations of the motions of the moon for the years 1935 to 2000. (To do this, he is said to have spent seven months punching 20 million holes in half a million Hollerith cards.)

Cray, Seymour (1925-1996)

Wisconsin-born inventor who made the computer "super" and fast with his innovations and also founded the Control Data Corp. along with William Norris and seven others. The long list of computers Cray designed or helped design includes the UNIVAC 1103 (for Sperry Rand), the 1604, the 6600, and the CDC 7600 (often considered the first supercomputer).



Seymour Cray
PHOTO CREDIT: CHARLES BABBAGE INSTITUTE, UNIVERSITY OF MINNEAPOLIS

Dean, Mark (1957 -)

IBM co-inventor (along with Dennis Moeller) of the 16-bit expansion bus, which is the circuitry that is the key component to the PC's success because it acts, essentially, as its spinal cord.

Delamain, Richard (1600-1644)

Student of William Oughtred who, in 1630, published the invention of the circular slide rule, an improvement on Edmund Gunter's Line of Numbers. This circular device wasn't particularly accurate, but it was practical and provided simple estimates for using logarithms to multiply two numbers together. Delamain is thought to have taken the idea from Oughtred, but there is a chance he developed the idea independently.

Dell, Michael (1965 -)

The founder, chairman, and CEO of Dell Computer Corp., one of the computer industry's most successful hardware companies. In 1984, Dell began selling computers from his dormitory room at the University of Texas-Austin. Dell Computer officially arose on May 3

that same year, and by 1986, the company had expanded to nearly 250 employees. Dell developed a buy-direct business model that eliminated middle layers of distribution between manufacturer and consumer. The incredibly successful model helped the young company become one of the top five computer vendors in the world in just 13 years, and helped the 30-something-year-old Michael Dell to become one of the world's richest men.

Michael Dell
PHOTO CREDIT: DELL

Drexler, Eric (1956-)

Conceptualized molecular nanotechnology in the late 1970s. He thought if people could design living molecules, they could design mechanical and electrical parts that small too. At M.I.T., Drexler received degrees in interdisciplinary science, engineering, and molecular nanotechnology. So afraid the new science would cause more harm than good, he restrained from publishing his first paper on nanotechnology until 1981. In 1986, he wrote "Engines of Creation," a book documenting his molecular nanotechnology work until that time. Today, Drexler is a Research Fellow for the Institute of Molecular Manufacturing and chairs the Foresight Institute. His present research objectives include creating computers smaller than living cells, and designing devices to repair cells.

Eckert, John Presper (1919-1995)

Pennsylvania physicist who worked with John W. Mauchly and a 50-member team to create the first general-purpose electronic calculator, known as the Electronic Numerical Integrator And Calculator (ENIAC), at the University of Pennsylvania in the Moore School of Electrical Engineering. The ENIAC is considered by some people to be the first electronic computer. Eckert, the chief engineer, handled the hardware, and Mauchly, the principal consultant, dealt with software and programming. The digital calculator, which used high-speed vacuum tubes, hierarchical memory, and subroutines, was funded by the U.S. War Department's Ballistics Research Laboratory to calculate firing trajectory tables during World War II. In 10 years at the Aberdeen Proving Grounds, the ENIAC was estimated to have done more arithmetic than the entire human race had done prior to 1945. Eckert and Mauchly had legal and personal disputes with Iowa State College's John Atanasoff about his role (or lack thereof) in the machine's development. The Moore team went on to build the Electronic Discrete Variable Computer, or EDVAC, which was faster and used the binary system instead of the decimal one, and Eckert and Mauchly later started a company to create the UNIVersal Automatic Computer, or UNIVAC, but eventually ran out of funding.

John Presper Eckert
PHOTO CREDIT: UNIVERSITY OF PENNSYLVANIA ARCHIVES

Engelbart, Douglas C. (1925-)

Oregon native who is famous for inventing and patenting the first computer mouse in 1963. He holds about 20 patents, mostly for basic features in microcomputing. He also created the first two-dimensional editing system and even unveiled such things as shared-screen viewing and mixed-text graphics, seeing early on that computers could be tools instead of giant adding machines. Finally, he founded the Bootstrap Institute, which encourages companies to collaborate on inventions.

Douglas Engelbart
PHOTO CREDIT: BOOTSTRAP INSTITUTE

Evans, Bob Overton (Bo) (1927-)

Nebraskan who helped create IBM's 360 series, which was the first family of compatible processors, a cornerstone for future computers, and the basis for IBM's huge growth. Evans was considered one of IBM's most durable and influential engineers until he left the company at age 57 for Hambrecht & Quist Inc.

Farnsworth, Philo Taylor (1906-1971)

Competes with both Thomas Edison and Alexan-der Graham Bell as the brainchild behind one of the most widely-used product in our culture, the television. Farnsworth's inventions of television images later spread to computer monitors. Farnsworth grew up in a log cabin in Utah, depending on a horse for getting to school and plowing the potato fields. As a 14 year old, Farnsworth and his horse were tilling a field one day, when he thought of electrons doing the same thing he was: going back and forth across the field. Farnsworth decided electrons should be able to scan images like lines in a book or rows in a potato field. Later, he moved to San Francisco to start what became Farnsworth Television Inc., of California. In 1927, he created the first television image. He patented scanning, focusing, synchronizing, contrast, controls, power, and other inventions. After World War II, his patents began to expire and Farnsworth nearly drowned in the wake of RCA, who capitalized on his idea.

Felt, Dorr E. (1862-1930)

The machinist who invented a key-driven business calculator known as the Comptometer. This calculator sped up calculations by adding the results as numbers were entered. He began working on the machine in 1884 with a wooden macaroni box, skewers, staples, and rubber bands. He ended up with a monopoly on desktop calculators for 15 years. The machine's main drawback was that it could not print, as the one created by William Burroughs would be able to do.

Filo, David (1966 -)

Chief Yahoo and Co-Founder of Yahoo!, currently the most popular site on the World Wide Web. As a Ph.D. candidate for Electrical Engineering at Stanford University, Filo and his colleague Jerry Yang began developing a way to store and list their favorite sites on the Internet. Using Yang's computer for the Web site list and Filo's computer as the search engine, they formed a comprehensive collection of sites, and developed codes and soft-

David Filo
PHOTO CREDIT: YAHOO

ware to fuel their new invention. In April 1994, they formally launched Yahoo!, which has become the leading brand name on the Internet.

Flowers, Thomas H.

Engineer who led the team that created a fast, digital, all-electronic machine called the Colossus, of which several copies were presumably used for British code-breaking during World War II. Flowers took his idea to the Dollis Hill Research Station in London after it was turned down by Bletchley Park, an estate in London that was the center of efforts to break the German military code. Ironically, less than a year later, the Colossus had been designed, constructed, and moved to Bletchley Park. It was functional by December 1943, and several more were installed June 1, 1944, five days before the Allies invaded Normandy.

Forrester, Jay Wright (1918-)

Jay Forrester

Nebraska native and MIT professor who made an important innovation in the way magnetic core memory was arranged and led the team that created Whirlwind, which was made to control flight simulators but ended up being used for any problems requiring real-time control. The magnetic memory, smaller and faster than vacuum tube memory, was necessary for Whirlwind to become operational in 1951.

Gates, William Henry III (1955-)

Seattle-born Harvard dropout who created a business partnership called Microsoft with his friend, Paul Allen, in 1975. Gates became president and chairman of the board of the company when it became a private corporation in 1981, and later assumed the official title of CEO. Under his guidance, Microsoft became one of the most successful companies in the world, and by 1998 had more than 27,000 employees and $14 billion in annual revenue. Gates is highly regarded as both a business leader and technical visionary, although some people claim he is an overly aggressive and ruthless competitor. Microsoft's fantastic business success has made Gates the most visible leader in the high tech industry, and he has become one of the best-known CEOs of this century. He also may be the richest person on earth, with a personal fortune estimated at more than $76 billion at the end of 1999's first quarter.

William Gates III

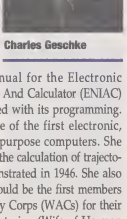
PHOTO CREDIT: MICROSOFT CORP.

Gerstner, Louis V., Jr.

IBM chief executive officer since 1993. Born in Mineola, New York, Gerstner earned degrees in engineering and business. After school, Gerstner worked at McKinsey and Company. He left McKinsey to lead American Express as the company's top executive for 11 years, followed by a four year stint as chairman and CEO of RJR Nabisco. Gerstner then took the helm of IBM at a low-point in the company's history. Since then, stock has tripled. Gerstner now steers the company towards network computing. He is an elected member of the National Academy of Engineering.

Geschke, Charles M.

The founder of Adobe Systems in 1982 who, along with John Warnock, went on to create what is now known to the world as desktop publishing.



Charles Geschke

Goldstine, Adele

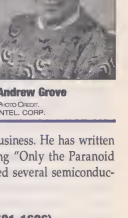
Mathematician who wrote the manual for the Electronic Numerical Integrator And Calculator (ENIAC) and also was involved with its programming. The ENIAC was one of the first electronic, large-scale, general-purpose computers. She wrote a program for the calculation of trajectory, which was demonstrated in 1946. She also helped train what would be the first members of the Women's Army Corps (WACs) for their jobs calculating trajectories. (Wife of Herman Goldstine.)

Goldstine, Herman Heine (1913-)

Mathematician who helped design one of the first electronic computers, the Electronic Numerical Integrator And Calculator (ENIAC), at the University of Pennsylvania. The ENIAC was one of the first electronic, large-scale, general-purpose computers. He also worked with John von Neumann on scientific papers at the Institute for Advanced Study (IAS) and went on to write one of the most complete computer history books. The book, however, is sometimes said to have been weakened because of its emphases on von Neumann (and sometimes controversial statements) and because he wrote it during a bitter lawsuit about the patent for the ENIAC. (Husband of Adele Goldstine.)

Grove, Andrew (1936-)

Former CEO of Intel Corporation whose goal to get a computer in front of everyone skyrocketed. Born in Bugapest, Hungary, Grove joined Intel at its founding in 1968. He became its president in 1979. Eight years later, he was Intel's CEO. He passed on his title of CEO to Craig Barrett in 1998, and now lectures at the Stanford Graduate School of Business. He has written many books, including "Only the Paranoid Survive," and patented several semiconductor technologies.



Andrew Grove

PHOTO CREDIT: INTEL. CORP.

Gunter, Edmund (1581-1626)

British mathematician and astronomer who created various measuring instruments that bear his name, including Gunter's Line of Numbers. This forerunner of the slide rule eliminated the mental work of addition and the need to look up logarithms on a table.

Hewlett, William R. (1913-)

Michigan-born engineer who, in 1939 along with David Packard, created Hewlett-Packard, a computer company that became famous primarily for its profitable line of desktop printers. Hewlett and Packard, who met while both were Stanford undergraduates, set up shop in a one-car garage in Palo Alto, Calif., and Silicon Valley was born. They got their first of

several patents—and their start as a business—when they created a resistor-capacitance audio oscillator, which Disney purchased to make the sound track for the film "Fantasia."

William R. Hewlett
PHOTO CREDIT: HEWLETT-PACKARD

Hoff, Marcian Edward Jr. (Ted) (1937-)

Intel engineer who created a general-purpose, programmable logic chip called the 4004. This first single-chip microprocessor had the circuitry of a central processor on one silicon chip and yielded the microcomputer when paired with only four other chips. Hoff was aided by Federico Faggin and Stanley Mazor.

Marcian "Ted" Hoff Jr.
PHOTO CREDIT: INTEL CORP.

Holberton, Betty (1927-)

One of a team of young women at the University of Pennsylvania who, in 1945, calculated trajectories to help wartime artillery gunners aim their weapons. When the The Electronic Numerical Integrator And Calculator (ENIAC) was invented, Holberton and five other women worked on it, becoming the world's first programmers. The ENIAC is known as one of the first electronic, large-scale, general-purpose computers. She and her cohorts had the task of breaking down complex differential equations into the smallest steps possible, making sure that each was routed to the right place and performed in the right order. Holberton, who was from Philadelphia, later influenced the development of the UNIVersal Automatic Computer (UNIVAC), shaping everything from its instruction codes and ease of use to its outward appearance. She continued in the computer field until 1983, leading the development of the COBOL (Common Business-Oriented Language) language for computers.

Hollerith, Herman (1860-1929)

New York-born engineer who developed a way to use punched cards to tabulate data for the U.S. Census Bureau's 1890 census. His Hollerith cards and associated machines revolutionized businesses (particularly the census and railroad businesses) in the United States and overseas. (It is said that John Shaw Billings, a high-ranking census official, gave Hollerith the idea for the cards.) Hollerith went on to found the Tabulating Machine Company, which in a roundabout way eventually became IBM.

Hopper, Grace Brewster Murray (1906-1992)

New York-born mathematician who has been called the first lady of software and the first mother-teacher of all computer programmers. She invented the first programming languages in the 1950s, for the MARK I and the UNIVAC I, and also invented the first compilers. She is often referred to as the woman who led the creation of COBOL (Common Business-Oriented Language) along with Charles Phillips. She was the first woman to get a doctorate in math from Yale, served as a Rear Admiral in the U.S. Naval Reserves (and eventually became the oldest serving officer), and influenced the design of military languages for many years. Yet "Amazing Grace" considered her greatest accomplishment not her strides in these fields and long list of honors and accomplishments, but the young people she trained and inspired.

Grace Hopper
PHOTO CREDIT: U.S. NAVAL HISTORICAL CENTER

Jacquard, Joseph-Marie (1752-1834)

French weaver who built a practical, fully automated loom programmed by punched cards. The system is believed to have inspired Charles Babbage to see a way to store programs, and Herman Hollerith used the idea to tabulate data. The looms are still in use.

Jobs, Steven Paul (1955-)

California college dropout who, along with Steve Wozniak, co-founded Apple Corp. after creating the Apple computer in Jobs' parents' garage. The pair later invented the phenomenally successful Apple II computer, which moved the computer industry into the big time and changed Apple Corp. from a garage-based company to a multimillion dollar one. Jobs was considered the ambitious one who controlled the business side. After he left Apple in 1985 (after a power struggle with president John Scully), he went on to co-found NeXT Computer, which later became NeXT Software Inc. Apple purchased this company in 1996, acquiring Jobs as a consultant.

Steven Jobs
PHOTO CREDIT: APPLE COMPUTER

Kapor, Mitchell (1950-)

New York-born software designer who created Lotus 1-2-3 with Jonathan Sachs, and founded the Lotus Development Corp. in 1982 in Cambridge, Mass. Kapor made Dan Bricklin's electronic spreadsheet (VisiCalc) a more powerful, friendly tool, and Lotus 1-2-3 has become one of the world's most widely-used applications. Kapor resigned from Lotus in 1986. Ironically, he had once tried (unsuccessfully) to interest IBM in the Lotus 1-2-3 spreadsheet; eventually, IBM ended up taking over Lotus. In 1990, along with Steve Wozniak, Kapor co-founded the Electronic Frontier Foundation, which is a nonprofit civil liberties group dedicated to understanding the social impact of the digital revolution in a free and open society. Kapor also founded ON Technology, a developer of software applications for workgroup computing, and he is now an adjunct professor in Media Arts and Sciences at MIT.

Kay, Alan C.

Mathematician who is best known for conceiving the basic concepts of high-level, object-oriented programming and subsequently designing Smalltalk, the first completely object-oriented language, while working at Xerox Palo Alto Research Center. Kay is sometimes called the father of the PC, and many of his ideas are common in the field of personal computing. He worked for Apple Computer since for over a decade.

Kemeny, John (1926-1992)

Hungarian native and Dartmouth mathematician who co-developed Beginner's All-Purpose

Symbolic Instruction Code (BASIC) in 1964, along with Thomas Kurtz, because the pair wanted a simple computer language. BASIC is often considered the beginner's bible in computing, and is included with almost every microcomputer. However, the language has numerous variations because the two men didn't copyright it. In the 1980s, they developed True BASIC, a more powerful version of BASIC that met ANSI and ISO standards. As a side note, as a doctoral student at Princeton, Kemeny was physicist Albert Einstein's research assistant.

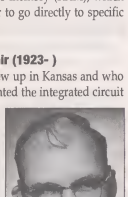
John Kemeny
PHOTO CREDIT:
DARTMOUTH LIBRARY ARCHIVES

Kilburn, Tom (1921-)

English electronics specialist who helped Frederic Williams develop cathode-ray storage tubes for the small-scale electronic machine (SSEM) developed at Manchester University. CRTs were the first form of high-speed random-access memory (RAM), which allows the computer to go directly to specific stored information.

Kilby, Jack St. Clair (1923-)

Engineer who grew up in Kansas and who independently invented the integrated circuit at Texas Instruments in 1945, at the same time as Robert Noyce at Fairchild Semiconductor. The integrated circuits saved space, did away with the time-consuming need for wiring components together, and enhanced reliability. Both Fairchild and Texas Instruments began mass-producing the circuits in 1962. In essence, the integrated circuit laid the foundation for modern microelectronics. Along with Jerry D. Merryman and James Van Tassel, Kilby also helped invent the first electronic handheld calculator by adapting the integrated circuit.



Jack St. Clair Kilby
PHOTO CREDIT:
TEXAS INSTRUMENTS INC.

King, Augusta Ada (Lady Lovelace) (1815-1852)

English thinker without a formal education who helped Charles Babbage with the Difference and Analytical Engines in a time when women generally didn't study mathematics. She was best known for translating from French to English a report on a lecture Babbage gave—she added her own lengthy notes to the text—and has been credited with developing the concepts of loop and subroutine. Babbage said that she explained the machine much better than he did and also seemed to understand it better. Some have called her the world's first programmer, or the first conceptual programmer, but others believe that she just clarified and analyzed Babbage's ideas rather than adding anything original of her own. King, who was born Augusta Ada Byron, was the only legitimate child of the poet Lord Byron, although she never met him. Ada, the U.S. Department of Defense's programming language, is named after her.

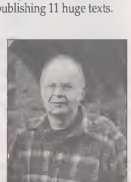
Augusta Ada King (Lady Lovelace)

Kircher, Athanasius (1602-1680)

German mathematician who, through his correspondence, helped spread John Napier's Bones from Europe to China in just a few years. Jesuits sent so many of their latest theories or inventions to Kircher, who was the unofficial information exchange for the Jesuits, that he couldn't keep up with the information. His former pupil, Gaspard Schott, came to help and ended up publishing 11 huge texts.

Knuth, Donald Ervin (1938-)

Milwaukee-born programmer, author, musician, and professor emeritus at Stanford who has written three volumes of a planned seven-volume book series entitled "The Art of Programming," which is a summary of basic computer science. It has been translated into several languages. Knuth also developed a scientific typesetting language called Tex and an alphabet design system called Metafont. He's published a scholarly book about the Bible, writes fiction, and built an 8-foot-high pipe organ.



Donald Knuth

Kurtz, Thomas (1928-)

Illinois-born mathematician who co-developed the Beginner's All-Purpose Symbolic Instruction Code (BASIC) in 1964 with John Kemeny because the pair wanted a simple computer language. BASIC, which is often considered the beginner's bible in computing, is still included with almost every microcomputer. However, the language has many variations because the two men didn't copyright it. In the 1980s, they developed True BASIC, a more powerful version of BASIC that meets ANSI and ISO standards.

Thomas Kurtz
PHOTO CREDIT:
THE B. PRAGG

Lake, Clair D. (1888-1958)

IBM engineer credited by Howard Aiken as one of the co-inventors of the Harvard-IBM MARK I, a large-scale calculating machine finished in 1944. It was noted for its reliability and accuracy and did calculations full-time for World War II. Aiken was considered the driving force of the project, but Lake has been credited with its implementation.

Leibniz, Gottfried Wilhelm (1646-1716)

German who invented the first machine that could easily add, subtract, multiply, and divide. This mechanical multiplier, created to help astronomers, could carry units between unit positions. Leibniz also advocated the binary system—now a foundation of computing—and was one of the inventors of calculus. He also is widely known for his work in philosophy.

Licklider, J.C.R. (1915-1990)

St. Louis-born computer visionary who foresaw the day when people would be able to communicate with each other online and theorized that the man-computer interaction would enhance both the efficiency and quality

of problem solving. Licklider headed the IPTO (Information Processing Technology Office) at ARPA (the U.S. Advanced Research Projects Agency) in the 1960s. While at his post, he established funding priorities for computer science research, which eventually led to the development of the Internet and the networking of computers.

Lovelace, Lady (1815-1852)

See King, Augusta Ada.

Ludgate, Percy E. (1883-1922)

Irish accountant who designed and perhaps constructed a mechanical analytical engine around the turn of the century, although little information is available about him, and his drawings and manuscripts have disappeared. The machine appears to have been quite different from Charles Babbage's and may have been powered by an electrical motor.

Maes, Pattie (1961 -)

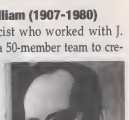
An associate professor with MIT's Artificial Intelligence Laboratory, where Maes founded and still leads the Autonomous Agents Group. A graduate of Brije Universiteit Brussel in Belgium, Maes specialized in artificial intelligence, artificial life, and human computer interaction. After coming to work at MIT in the United States in 1995, Maes founded Agents Inc., one of the first companies to commercialize software agent technology. Then in 1996, Agents Inc. took on a new name and became Firefly Network Inc., which grossed an estimated $100 million in 1997 by signing agreements with companies such as My Yahoo! and Barnes & Noble. Currently, Maes runs her multi-million dollar company, still works at MIT, and is the Sony Corporation Career Development Chairwoman. During 1997, Maes was selected for the following: Newsweek's 100 most important people to watch; the World Economic Forum's 100 people to listen to; the Association for Computing Machinery's 15 most perspicacious visionaries; and People Magazine's 50 most beautiful people.

Markkula, A. C. "Mike"

Former Intel executive who invested in Apple early on, essentially becoming a third partner to Steve Wozniak and Steve Jobs. He attracted attention and talent to the small company that would eventually become one of the leading forces in the PC industry's evolution.

Mauchly, John William (1907-1980)

Ohio-born physicist who worked with J. Presper Eckert and a 50-member team to create the first electronic, large-scale, general-purpose calculator, known as the Electronic Numerical Integrator And Calculator, or ENICA, at the University of Pennsylvania in the Moore School of Electrical Engineering. The ENIAC is considered by some to be the first electronic computer. Mauchly, the principal consultant, dealt with software and programming, while Eckert, the chief engineer, handled just the hardware. The digital calculator, which used high-speed vacuum tubes, hierarchical memory, and subroutines, was funded by the U.S. War Department's Ballistics Research Laboratory to calculate firing trajectory tables during World War II. Eckert and Mauchly had legal and personal disputes with Iowa State College's John Atanasoff about his role (or lack thereof) in the machine's development. The Moore team went on to build the Electronic Discrete Variable Computer (EDVAC), which was faster, used binary instead of decimal, and had stored-program capability. Eckert and Mauchly later started a company to create the UNIVAC (UNIVersal Automatic Computer) but eventually ran out of money.



John Mauchly
PHOTO CREDIT: UNIVERSITY OF PENNSYLVANIA ARCHIVES

McCarthy, John (1927-)

Boston-born mathematician who is considered to be one of the fathers of artificial intelligence for coining the term and for his work in helping computers reason more like humans. He also created the programming language LISP (an acronym for LISt Processor) in 1958, which he has said represents common-sense knowledge.

Metcalfe, Robert (1946-)

New York native who led the creation of Ethernet, which linked the minicomputers found at the Xerox Palo Alto Research Center (PARC) in 1973. Ethernet is now a widely used local-area network (LAN) protocol that connects more than 50 million computers. He later went on to found 3Com, a successful global data network company.

Robert Metcalfe
PHOTO CREDIT: 3COM

Moore, Gordon (1929-)

California native who helped Robert Noyce develop the semiconductor chip at Fairchild Semiconductor in 1958, at the same time that Jack Kilby was inventing one at Texas Instruments. Noyce and Moore later co-founded the Intel Corp.

Gordon Moore
PHOTO CREDIT: INTEL CORP

Morland, Samuel (1625-1695)

English mathematician who invented three different adding machines: a simple but reliable one with no carrying mechanism, a mechanical version of John Napier's Bones, and what's known as a trigonometrical calculating machine.

Myhrvold, Nathan

Chief technology officer for Microsoft and a member of its Executive Committee. Myhrvold also oversees the Advanced Technology and Research Group. Before his present assignments, he was Microsoft's group vice president of Applications and Content, which includes Desktop Applications, Consumer, Research, and Microsoft Online Systems departments. In 1991, Bill Gates and Myhrvold founded Microsoft Research, a division of Microsoft devoted to computer science advances. Myhrvold holds advanced degrees in geophysics, space physics, mathematical economics, and theoretical and mathematical physics. He studied post-doctoral physics with Stephen Hawking at Cambridge University. He founded Dynamical Systems,

and joined Microsoft when the software giant swallowed his company. In addition to his Microsoft work, Myhrvold is a member of the National Information Infrastructure Council and sits on the board of trustees for the Institute of Advanced Study in Princeton.

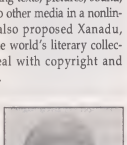
Napier, John (1550-1617)

Scottish theologian and mathematician who discovered logarithms (reportedly at the same time as the Swedish mathematician Jobst Burgi), which had a tremendous impact on the scientific world. He also created what became known as Napier's Bones, a set of cylinders that solved multiplication problems, and spent much of his life trying to find ways to make arithmetic less laborious. However, he didn't consider his discoveries important and only published them at the urging of his friends.

Nelson, Ted (1937-)

Person who coined the term hypertext in 1965. Hypertext refers to text that doesn't need to be linear, meaning it can link to or reference other texts. Nelson was one of the first to implement hypertext and the subsequent hypermedia (describing texts, pictures, sound, and video that link to other media in a nonlinear way). Nelson also proposed Xanadu, which would put the world's literary collection online and deal with copyright and accounting problems.

Norris, William (1911-)



William Norris
PHOTO CREDIT:
CHARLES BABBAGE INSTITUTE, UNIVERSITY OF MINNESOTA, MINNEAPOLIS

Nebraska engineer who founded the Control Data Corp. and spawned the supercomputer industry. He gave Seymour Cray free rein to develop a supercomputer line that included the 6600, which turned out to be the most powerful machine of its time.

Noyce, Robert N. (1927-1990)

Iowa electrical engineer who independently invented the integrated circuit in 1958 at Fairchild Semiconductor with the help of Gordon Moore, at the same time Jack Kilby was inventing it at Texas Instruments. Noyce used a planar process and discovered that silicon's conductivity was better than germanium's. The integrated circuits saved space, did away with the time-consuming need for wiring components together, and enhanced reliability.

Robert Noyce
PHOTO CREDIT:
INTEL CORP.

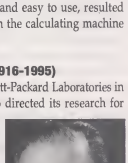
Both Fairchild and Texas Instruments began mass-producing the circuits in 1962. Noyce went on to co-found Intel Corp. in 1968, along with Moore, and in 1988, Noyce was named CEO of Sematech, a government-industry consortium that succeeded in its goal of advancing computer chip technology in the United States.

Odhner, Willgodt (1845-1905)

A Swede working in Russia who created the first properly constructed variable-toothed gear in Europe in about 1875 at the same time Frank Baldwin was making a similar one in the United States. The gear, which was reliable, small, and easy to use, resulted in a breakthrough in the calculating machine industry.

Oliver, Bernard (1916-1995)

Founder of Hewlett-Packard Laboratories in the early 1950s who directed its research for approximately 30 years, from the first programmable desktop calculators to the first handheld calculators to the company's first computers. In cooperation with John Cage, Oliver edited (and even wrote part of) the classic "Electronic Measurements and Instrumentations."



Bernard Oliver
PHOTO CREDIT:
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Olsen, Kenneth Harry (1926-)

The Connecticut-born electrical engineer who built a computer to test magnetic memory and helped build Whirlwind. He also co-founded Digital Equipment Corp. (purchased by Compaq Computers in 1998) with Harlan Anderson.

Kenneth Olsen
PHOTO CREDIT:
ADVANCED MODULAR SOLUTIONS INC.

Osborne, Adam (1939-)

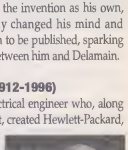
Introduced the first commercially successful portable computer in 1981. The Osborne I came out of the box ready to use and complete with applications, but it weighed almost 25 pounds and was about the size of a suitcase.

Oughtred, William (1575-1660)

The English clergyman and mathematician usually credited with inventing the circular slide rule, which was an improvement on Edmund Gunter's Line of Numbers. This circular device wasn't particularly accurate, but it was practical and provided simple estimates for using logarithms to multiply two numbers. Oughtred apparently didn't immediately publish his invention because of his disdain for mathematical toys. When one of his students, Richard Delamain, published the invention as his own, Oughtred apparently changed his mind and allowed the invention to be published, sparking a lifetime of debate between him and Delamain.

Packard, David (1912-1996)

Colorado-born electrical engineer who, along with William Hewlett, created Hewlett-Packard, a computer company that became famous primarily for its profitable line of desktop printers. Hewlett and Packard, who met while both were Stanford University undergraduates, set up shop in a one-car garage in Palo Alto, Calif., and Silicon Valley was born.



David Packard
PHOTO CREDIT:
HEWLETT PACKARD

They got their first of several patents—and their start as a business—when they created a resistor-capacitance audio oscillator, which Disney purchased to make the sound track for the film "Fantasia."

Pascal, Blaise (1623-1662)

French mathematician and philosopher who at age 19 invented a machine that could add and subtract with the turn of wheels and also carry between digits (for instance, making a 9 turn over to a 0). Because workmen weren't used to building such delicate equipment, Pascal had to train himself as a mechanic before he could build the machine. Later in life, Pascal became religious and philosophical and abandoned math and science.

Rajchman, Jan A. (1911-1989)

England-born Pole who led a team that developed a digital electrostatic storage tube at RCA Laboratories in the United States.

Ritchie, Dennis M. (1941-)

New York-born computer scientist who deserves much of the credit (along with Ken Thompson) for the development in 1973 of Unix, a multi-user operating system that gave users previously unthinkable features and was machine-independent, relatively small, and affordable. The 1969 venture was among AT&T Bell Telephone Labs, General Electric, and MIT, but Bell Labs was the first user. Unix has influenced MS-DOS, Microsoft Windows, and the Apple Macintosh operating systems. Ritchie also developed the C programming language.

Roberts, H. Edward

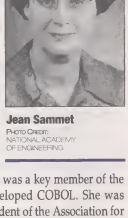
American Air Force officer who, along with three friends, founded the Micro Instrumentation and Telemetry Systems (MITS), which thrived when in 1971 it began producing the first large-scale integrated calculator kit in the United States. The company soon hit the jackpot with the introduction of the Altair, an affordable but rudimentary computer kit that uncovered a huge market for microcomputers. Roberts, a man often credited with the invention of the term personal computer, is now a small-town medical doctor.

Roberts, Larry

Considered to be the father of the ARPANet, Roberts understood the potential benefits of networking computers together. The ARPANet is a worldwide network created in the 1960s by the U.S. Department of Defense to facilitate communication between research organizations and universities. It is considered the forefather of the Internet. Roberts believed, as J. C. R. Licklider did, that networking would encourage "a 'community' use of computers." Roberts used a dedicated phone line to connect a TX-2 computer to a computer at Systems Development Corp. in Santa Monica, Calif. Though this rudimentary link permitted one computer to log on to the other and run programs there, it was disappointingly slow. Eventually, it was Roberts' dedication, design, and direction that brought about the success of the ARPANet.

Sammet, Jean E. (1928-)

New York-born leading expert on the history of programming languages. She led to the development of FORMAC, the first widely-used language for manipulating symbolic mathematical expressions, while at IBM and also wrote "Pro-gramming Languages: History and Fundamentals," which was considered the standard book about programming languages. She was a key member of the committee that developed COBOL. She was the first female president of the Association for Computing Machinery (ACM), the main professional society of the computer industry.



Jean Sammet
PHOTO CREDIT:
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Scheutz, Georg (1785-1873) and Edvard Raphael (1821-1881)

Father-and-son team of Swedish engineers who, in 1853, constructed an operational Difference Engine that was modeled after Charles Babbage's plans. Although it didn't make the family rich or particularly famous, it demonstrated that the machine could be constructed with the technology of the day.

Schikard, Wilhelm (1592-1635)

German astronomer, linguist, mathematician, and minister who in 1623 is thought to have created the first workable adding machine, which incorporated John Napier's logarithms, could multiply and divide through repeated addition and subtraction, and was able to carry the value when a 9 turned over to a 0. There is evidence that the machine was built, but no original drawings or copies of have been found.

Schott, Gaspard (1608-1666)

German mathematician who, along with Athanasius Kircher, aided in the spread of John Napier's Bones from Europe to China in just a few years. Based upon correspondence sent to Kircher, the unofficial information exchange for the Jesuits, Schott produced 11 huge texts of new mathematical methods.

Schreyer, Helmut (1912-1984)

German engineer who, as a graduate student, helped Konrad Zuse design and build his mechanical and electromechanical computers. Schreyer also experimented with (and is credited with the idea of) using vacuum and neon tubes instead of electromechanical relays.

Shannon, Claude Elwood (1916-)

Michigan-born mathematician who wrote several influential papers, including one in 1937 that set the stage for digital computers and another in 1948 that founded information theory. He also wrote a paper that described the stored-program computer, which led to the development of John von Neumann's digital, all-purpose electronic calculating device. The International Standards Organization (ISO) named the shannon, to be a unit of measurement for information content, after him. Shannon has also been recognized by some as the first person to use the word "bit."

Shockley, William Bradford (1910-1989)

British co-inventor of the transresistor, or transistor, and a member of the AT&T Bell Telephone Laboratories team with John Bardeen and Walter Brattain. The transistor had the same capabilities as a vacuum tube but was faster, broke less often, and used less power. The three shared a Nobel Prize in physics in 1956.

William Shockley
PHOTO CREDIT:
AT&T ARCHIVES

Stibitz, George Robert (1904-1995)

American mathematician at AT&T Bell Telephone Laboratories who invented several computers, the first of which used Boolean logic to add, subtract, multiply, and divide complex numbers. This Complex Number

Calculator, completed in 1939, provided the foundation for digital computers and was also the first machine to be used from a remote location. Samuel Williams helped with the machine and made it easier to use by adding buttons. Stibitz is generally considered the inventor of one of the first digital computers.

George Stibitz
PHOTO CREDIT: AT&T ARCHIVES

Stroustrup, Bjarne (1950-)

Dane who invented the C++ programming language, which is the object-oriented version of C. He also wrote two books about the language.

Teal, Gordon K. (1907-)

Texas-born Texas Instruments physicist who, in 1954, perfected a way of making transistors out of silicon, one of the most common elements, instead of using germanium, which cost more than gold.

Gordon Teal
PHOTO CREDIT: TEXAS INSTRUMENTS INC

Thomas de Colmar, M. Charles Xavier (1785-1870)

Frenchman who in 1820 used some of Gottfried Leibniz's ideas to create the first reliable, useful, commercially successful calculating machine. Although the Thomas Arithmometer was large enough to cover a desk, he created an industry to manufacture and sell it.

Torvalds, Linus (1970 -)

Otherwise known as the Father of Linux, (pronounced LEE-nucks) the first open source (or free) operating system software. As a college student, Torvalds, with inspiration from a Unix course he was taking at Helsinki University in Finland, began developing his own line of code. A firm believer in sharing the wealth with other hackers, Torvalds posted his preliminary codes in Usenet newsgroups; fellow hackers then corresponded with him, offering suggestions and changes to the new OS. Originally, Torvalds dubbed the new code Linux, but decided upon Freax (a combination of free + freak + x) so as not to appear arrogant for naming the code after himself. Nevertheless, the original name stuck, and in 1997 Linux was installed on an estimated more than 10 million computers worldwide. Torvalds now works for Trans-Media Corp.

Linus Torvalds
PHOTO CREDIT: CHRISTOPHER GARDNER

Tramiel, Jack

Auschwitz survivor who founded Commodore International, which released the PET (Personal Electronic Transactor) in 1978 and began the microcomputer race with Tandy Radio Shack and Apple Computer. Tramiel later sold the Texas-based company to buy Atari from Warner Communications.

Turing, Alan Mathison (1912-1954)

English mathematician who was crucial in the work at Bletchley Park designing the Colossus, which deciphered German code during World War II and is considered by some to be the first electronic computer. Specifics about what he did are still covered under the British Official Secrets Act. Turing published a paper called "On Computable Numbers" that outlined, basically, the modern computer and still influences modern computer programmers. He was considered an eccentric among the eccentric personalities of his field and was known, among other things, for his crowing laugh and for riding his ancient bike with a gas mask because of his hay fever. He later invented the Turing Test, in which he proposed that if a computer could pass his test, it had proven that it could think. (So far, no computer has passed.) Authorities during the war apparently did not realize he was a homosexual, but he was convicted in 1952 for unnatural acts and forced to take female hormones. He died two years later, after knowingly eating an apple dipped in strychnine. It's debated whether the act was suicide or an experiment that failed.

von Neumann, John (1903-1957)

Hungarian mathematician who in 1945 wrote a memo outlining the five key parts of the modern computer, based upon work being done by John Mauchly and J. Presper Eckert for the EDVAC. The memo was accidentally distributed to the public, and it gave the computer scientific credibility but angered Mauchly and Eckert because of the credit von Neumann ended up receiving for their work. He also was involved in the Manhattan Project in Los Alamos, N.M., and proved the mathematical soundness of the implosive method of detonating the atomic bomb. He is generally considered the inventor of the stored-program computer.

Waitt, Ted (1963 -)

Co-founder, chairman, and CEO of Gateway, a South Dakota-based computer systems manufacturer. After dropping out of the University of Iowa in 1985, Waitt and a partner, now Senior Vice President of Marketing Michael Hammond, scraped together their concept inside a barn on the Waitt family's farm. Starting out with a $10,000 loan from Waitt's grandmother, Waitt and Hammond earned $100,000 during their first four months in business. Utilizing a unique marketing ploy, Waitt incorporated his roots into the company, adopting a Holstein print as Gateway's logo and handing out cow-shaped cookies at computer conventions. The down-on-the-farm approach worked—Gateway's 1998 sales topped $7 billion.

Ted Waitt
PHOTO CREDIT: GATEWAY

Wang, An (1920-1990)

Chinese physicist and engineer who invented and patented magnetic core storage while working at Harvard University for Howard Aiken. IBM was slow to recognize the potential of the storage method but eventually bought it for a ridiculously low price considering that magnetic string memories ended up making stored-program computers commercially practical. Wang later founded his own company (in Boston), Wang Laboratories Inc., of which he and his family

kept close control. The company created the first desktop computer and also developed word processing in which text editing could be done on-screen. On a broader scale, the success of Wang (known by many as simply "the Doctor") in the Caucasian establishment is said to have motivated other Chinese to follow his example.

Warnock, John E.

Invented PostScript PDL (Page-Description Language), a major factor leading to the desktop publishing revolution. He and Charles Geschke were the founders of Adobe Systems in 1982 to create desktop publishing.

Watson, Thomas J. (1874-1956)

New York-born president of the International Business Machines (IBM) Corp. who built up the company during World War II and also invested in Howard Aiken's plan to build the Harvard-MARK I calculator. Aiken eventually snubbed Watson's and IBM's role in the project, establishing a lifelong rift between the two men.

Watson, Thomas J. Jr. (1914-1993)

Took over his father's position as president of IBM in 1952, convinced that the company should build and market computers. He eventually led the company to having total domination of the computer market.

Wilkes, Maurice Vincent (1913-)

English mathematician who designed and constructed the Electronic Delay Storage Automatic Calculator (EDSAC), which was a stored-memory computer (made up of 16 steel tubes and 3,000 vacuum tubes) that could be programmed in English and perform addition in 1.4 milliseconds. The EDSAC is considered by some to be the first electronic computer. Wilkes was inspired in 1946 by a series of lectures at the Moore School of Engineering and named his computer after the EDVAC. Wilkes, who was director of Cambridge University's University Mathematical Laboratory, later constructed the EDSAC 2, which is the first computer to have a micro-programmed control unit.

Williams, Frederic Calland (1911-1977)

English engineer who, with the help of Tom Kilburn, developed cathode-ray tube (CRT) storage for the small-scale electronic machine (SSEM), which first ran in 1948, at Manchester University. CRTs were the first high-speed random-access memory (RAM), which allowed the computer to go directly to specific stored information. The SSEM is considered by some to be the first computer.

Williams, Samuel B.

American engineer for AT&T Bell Telephone Laboratories who, in 1939, oversaw the production of George Stibitz's powerful calculating machine that could add, subtract, multiply, and divide complex numbers. He helped with the design, including the addition of buttons to make the Complex Number Calculator easier to use.

Wirth, Niklaus (1934-)

Swedish language designer who aimed to keep programming languages simple and make them use less space. He created Oberon, an object-oriented programming language and operating system that used 1.5 megabytes (MB) of random-access memory (RAM). He also created Mod-ula-2 (a predecessor of Oberon) and Pascal.

Nicklaus Wirth

Wozniak, Steven Gary (1950-)

Electrical engineer from California who co-founded Apple Computer in cooperation with Steve Jobs after creating the Apple computer in Jobs' parents' garage. (Wozniak is generally considered the father of the Apple, while Jobs is considered the ambitious person who drove the company to succeed.) Some people consider "Woz" the person most responsible for making the PC and Silicon Valley what they are today. In 1985, he left Apple for his own company, CL-9 (Cloud 9), which designed remote control products, and reportedly vowed that he wanted to abandon the computer business for good. However, he now devotes his time to helping young people learn about computers. He also helped Mitch Kapor found the Electronic Frontier Foundation, which is a non-profit civil liberties group dedicated to understanding the social impact of the digital revolution and protecting online freedom.

Yamachita, Hideo (1899-1993)

Japanese engineer considered the father of Japan's computer industry. He created an all-electrical statistical calculation machine that used binary logic and relay circuits, and he also led the team in 1950 that created Japan's first large electronic computer, the Tokyo Automatic Calculator (TAC), with vacuum tubes. The TAC became the basis for the country's first all-transistor computers. He also founded the Information Processing Society of Japan.

Yang, Jerry Chih-Yuan (1968 -)

The co-founder of Yahoo!, the most popular destination on the World Wide Web. As a Ph.D. candidate for Electrical Engineering at Stanford University, Yang and his friend, David Filo, got sidetracked and developed a way of categorizing World Wide Web sites that helped fellow Internet users locate information. The two decided to start up a company in 1994, and now jointly hold the title of Chief Yahoo.

Jerry Chih-Yuan Yang

PHOTO CREDIT: YAHOO!

Zuse, Konrad (1910-1995)

German engineer who in 1938 created the Z1, one of the first binary digital computers, which was destroyed during World War II. It wasn't electronic, and it did not have a stored program, but it could be controlled through a punched tape and was what Charles Babbage had in mind when he dreamed of a computer. The Z1 is considered by some to be the first computer. Zuse also developed the successors Z2, Z3, and Z4 (the last of which was the only one to survive the war). He and Helmut Schreyer submitted a proposal to the Nazi government to make the Z3 machine 1,000 times faster by using vacuum tubes instead of electromechanical relay switches, but the Nazi government did not support Zuse's work because Hitler was confident he would win the war before Zuse finished the machine.

Konrad Zuse

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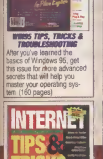

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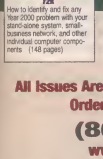

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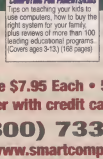

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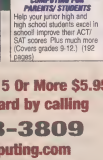

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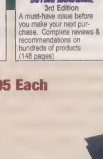

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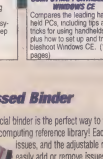

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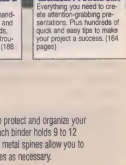

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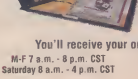

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100 Top High-Tech Companies

Due to size limitations we could only list 100 of the top companies here. For a more comprehensive list, and photos of many of the industry's leading CEOs and chairpersons, visit our Web site at http://www.smartcomputing.com.

Market capitalizations and revenues are for the end of the company's last fiscal year unless otherwise noted. Revenues are gross reported revenues unless stated otherwise.

#

3Com

Business description: manufactures Ethernet peripherals and modems
Date founded: 1979; Founded by: Dr. Robert Metcalfe
Current CEO: Eric A. Benhamou, 1990
Current number of employees: 13,000
Estimated revenues for last fiscal year: $5.4 billion
Market capitalization: n/a
Primary products: Ethernets, modems, handheld portables, Ethernet hubs, and remote access equipment
Phone #: (800) 638-3266; (408) 326-5000
Street address: 5400 Bayfront Plaza, Santa Clara, CA 95052
Fax #: (408) 326-5001
Web address: http://www.3com.com
Comments: 3Com is a top supplier of data, voice, and video communications technology; it was founded by the co-inventor of Ethernet

A

Acer America Corp.

Business description: manufactures PCs and peripherals
Date founded: 1976; Founded by: Stan Shih
Current CEO/Chairperson: Stan Shih, 1976
Current number of employees: 28,000
Estimated revenues for last fiscal year: $6.7 billion
Market capitalization: $4 billion
Primary products: personal computers, motherboards, communications products, and computer peripherals
Phone #: (800) 368-2237; (408) 432-6200
Street address: 2641 Orchard Parkway, San Jose, CA 95134
Fax #: (408) 922-2933
Web address: http://www.acer.com
Comments: Acer is one of the largest PC producers in the world, and it manufactures personal computers, motherboards, communications products, computer peripherals, semiconductors, and consumer electronics

Adaptec Inc.

Business description: designs software and computer accessories
Date founded: 1981; Founded by: Larry Boucher
Current CEO: Bob Stephens
Current Chairperson: Larry Boucher
Current number of employees: 2,500
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: Easy CD Creator Deluxe Edition, cables, and converters
Phone #: (800) 959-7274; (408) 945-8600
Street address: 691 S. Milpitas Blvd., Milpitas, CA 95035
Fax #: (408) 262-2533
Web address: http://www.adaptec.com
Comments: Adaptec develops products for transferring data from the PC to a peripheral device or network

Adobe Systems

Business description: produces software for corporations and consumers
Date founded: 1982; Co-Founded by: Dr. Charles Geschke and Dr. John E. Warnock
Current CEO: Dr. John E. Warnock, 1982
Current Chairperson: Dr. Charles M. Geschke, 1982
Current number of employees: 2,600
Estimated revenues for last fiscal year: $895 million
Market capitalization: $2.9 billion
Primary products: PageMill, PageMaker, Acrobat Reader, PhotoDeluxe
Phone #: (800) 833-6687; (408) 536-6000
Street address: 345 Park Ave., San Jose, CA 95110-2704
Fax #: (408) 537-6000
Web address: http://www.adobe.com
Comments: Adobe produces publishing and imaging programs and is one of the largest desktop software companies in the world

Advent Software

Business description: manufactures software for investment management professionals
Date founded: 1983; Founded by: Stephanie DiMarco
Current CEO/Chairperson: Stephanie DiMarco, 1983
Current number of employees: 500
Estimated revenues for last fiscal year: $71 million
Market capitalization: $560 million
Primary products: Axys, Geneva, Moxy, Advent Partner
Phone #: (800) 685-7688; (415) 543-7696
Street address: 301 Brannen, 6th Floor, San Francisco, CA 94107
Fax #: (415) 543-5070
Web address: http://www.advent.com
Comments: Advent produces software, data integration tools, and services for investment management professionals

Altec Lansing Technologies Inc.

Business description: develops audio solutions
Date founded: 1986; Founded by: Edward Anchel
Current CEO/Chairperson: Edward Anchel, 1986
Current number of employees: 1,000
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: speakers, subwoofers, and home theatre systems
Phone #: (800) 258-3288; (570) 296-6444
Street address: P.O. Box 277, Milford, PA 18337-0277
Fax #: (570) 296-6887
Web address: http://www.altecmm.com
Comments: Altec Lansing develops advanced audio systems and supplies speakers to major computer manufacturers

Advanced Micro Devices Inc. (AMD)

Business description: manufactures processors for desktops and notebooks
Date founded: 1969; Founded by: W. J. Sanders, III
Current CEO/Chairperson: W. J. Sanders, III, 1969
Current number of employees: 13,800
Estimated revenues for last fiscal year: $2.5 billion
Market capitalization: $2.7 billion
Primary products: semiconductors and processors, such as K6-2, K-6-III
Phone #: (800) 538-8450; (408) 732-2400
Street address: One AMD Place, P.O. Box 3453, Sunnyvale, CA 94088-3453
Fax #: (408) 749-2036
Web address: http://www.amd.com
Comments: AMD builds processors for PCs, flash memory devices, and networking products

America Online (AOL)

Business description: world's largest online service; provides customers with online content and access to the Internet
Date founded: 1985; Founded by: Stephen M. Case
Current CEO/Chairperson: Stephen M. Case, 1985
Current number of employees: 12,000
Estimated revenues for last fiscal year: $3 billion
Market capitalization: $118 billion
Primary products: AOL service, AOL Studios, CompuServe Interactive Services, AOL Instant Messenger, AOL.COM, and AOL NetFind
Phone #: (800) 827-6364; (703) 448-8700
Street address: 22000 AOL Way, Dulles, VA 20166
Fax #: (703) 883-1509
Web address: http://www.aol.com
Comments: AOL is a global leader in interactive services

Apple Corp.

Business description: manufactures software, consumer and business systems, and notebooks based on the Macintosh technology
Date founded: 1977; Founded by: Steven Paul Jobs and Steve Wozniak
Current Interim CEO: Steven Paul Jobs
Current number of employees: 8,788
Estimated revenues for last fiscal year: $2.3 billion
Market capitalization: n/a
Primary products: iMac, Power Macintosh G3, PowerBook G3, Mac OS 8.6, QuickTime
Phone #: (800) 538-9696; (408) 996-1010
Street address: 1 Infinite Loop, Cupertino, CA 95014-2084
Fax #: (408) 974-2113
Web address: http://www.apple.com
Comments: Apple takes credit for "igniting" the personal computer revolution in the 1970s with the Apple II and for "reinventing" the PC in the 1980s with the Macintosh

Avery

Business description: produces and supplies consumer software and office supplies
Date founded: 1935; Founded by: R. Stanton Avery
Current CEO: Philip Neal, 1998
Current Chairperson: Charles Miller, 1998
Current number of employees: 16,000
Estimated revenues for last fiscal year: $3.5 billion
Market capitalization: n/a
Primary products: Avery LabelPro, Avery Personal Creations Cards
Phone #: (800) 462-8379; (626) 304-2000
Street address: 50 Pointe Drive, Brea, CA 92821
Fax #: (626) 598-2905
Web address: http://www.avery.com
Comments: Avery software lets users design labels for laser and inkjet printers and create greeting cards

B

Berkeley Systems

Business description: manufactures screen savers and entertainment software
Date founded: 1987; Founded by: Wes Boyd and Joan Blades
Current General Manager: Kory Stradinger
Current number of employees: 80
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: You Don't Know Jack, After Dark screen savers, Austin Powers: Operation Trivia, Cosmic Consensus, After Dark Games, and Acrophobia
Phone #: (800) 757-7707; (510) 540-5535
Street address: 2095 Rose St., Berkeley, CA 94709-4303
Fax #: (510) 549-3978
Web address: http://www.berksys.com
Comments: The company's You Don't Know Jack changed the way people looked at computer trivia games

Boca Research Inc.

Business description: manufactures modems and network peripherals
Date founded: 1985; Founded by: Timothy Farris
Current CEO: Anthony F. Zalenski, 1994
Current Chairperson: Robert W. Ferguson, 1997
Current number of employees: 260
Estimated revenues for last fiscal year: $70 million
Market capitalization: $27.3 million
Primary products: Tidalwave modem, HAN (Home Area Network) Card, and WinStorm modem
Phone #: (561) 997-6227
Street address: 1377 Clint Moore Road, Boca Raton, FL 33487-2722
Fax #: (561) 997-0918
Web address: http://www.bocaresearch.com
Comments: Boca Research builds modems and network cards to get your PC connected to the Internet or corporate network

Brother International Corp.

Business description: develops office machines for home office or corporations
Date founded: 1954; Founded by: Max Hugel, Bernie Etzin, and Roy Nakagawa
Current CEO/Chairperson: Mr. Hiromi Gunji, 1986
Current number of employees: 3,674
Estimated revenues for last fiscal year: $1.1 billion
Market capitalization: n/a
Primary products: laser printers, fax machines, and multifunction devices
Phone #: (800) 276-7746; (908) 704-1700
Street address: 100 Somerset Corporate Blvd., P.O. Box 6911, Bridgewater, NJ 08807-0911
Fax #: (908) 704-8235
Web address: http://www.brother.com
Comments: Brother started with sewing machines in 1934; today it produces laser printers and multifunction devices

C

Canon USA

Business description: imaging products
Date founded: 1933; Founded by: n/a
Current CEO: Fujio Matarai
Current Chairperson: Ryuzaburo Kaku

Current number of employees: 11,000
Estimated revenues for last fiscal year: $24.3 billion
Market Capitalization: n/a
Primary products: printers, digital cameras, business machines, and scanners
Phone #: (800) 652-2666; (516) 328-5000
Street address: One Canon Plaza, Lake Success, NY 11042-1198
Fax #: (516) 328-5069
Web address: http://www.usa.canon.com
Comments: Canon makes imaging products—including cameras, printers, scanners, and business machines—for the home or office

Cisco Systems Inc.

Business description: produces networking peripherals and solutions
Date founded: 1984; Founded by: Sandy Lerner and Lynn Bosack
Current CEO: John Chambers
Current number of employees: 18,300
Estimated revenues for last fiscal year: $8.5 million
Market capitalization: n/a
Primary products: routers, wide-area network solutions and local area network switches
Phone #: (800) 553-6387; (408) 526-4000
Street address: 170 W. Tasman Drive, San Jose, CA 95134-1706
Fax #: (408) 526-4100
Web address: http://www.cisco.com
Comments: Cisco specializes in networking for the Internet

Compaq

Business description: develops desktops, notebooks, servers, and storage products for the home and office
Date founded: 1982; Founded by: Rod Canion, Jim Harris, and Bill Murto
Current CEO/Chairperson: Benjamin M. Rosen, 1999
Current number of employees: 69,000
Estimated revenues for last fiscal year: $31.2 billion
Market capitalization: $71.3 billion
Primary products: computers, network storage, and desktop and portable products
Phone #: (800) 345-1518; (281) 370-0670
Street address: 20555 State Highway 249, Houston, TX 77070-2698
Fax #: (281) 514-4583
Web address: http://www.compaq.com
Comments: Compaq is one of the largest computer companies in the world

CompuServe
(Subsidiary of America Online)

Business description: online service that provides customers with online content and access to the Internet
Date founded: 1969; Founded by: Jeff Wilkins
Current CEO: Audrey Weil, 1998
Current number of employees: 500
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: CompuServe Internet service; CompuServe Custom Solutions, and CompuServe.com
Phone #: (800) 848-8199; (614) 457-8600
Street address: 5000 Arlington Center Blvd., Columbus, OH 43220
Fax #: (614) 723-1660
Web address: http://www.compuserve.com
Comments: CompuServe is one of the original Internet online service pioneers

Computer Associates

Business description: specializes in business software
Date founded: 1976; Founded by: Charles B. Wang and three associates
Current CEO/Chairperson: Charles B. Wang, 1976
Current number of employees: 14,000
Estimated revenues for last fiscal year: $4.7 billion
Market capitalization: n/a
Primary products: ARCserve*IT* Jasmine, Opal
Phone #: (800) 225-5224; (516) 342-5224
Street address: One Computer Associates Plaza, Islandia, NY 11788-7000
Fax #: (516) 342-5734
Web address: http://www.cai.com
Comments: Computer Associates provides business software, support, and integration services

Connectix Corp.

Business description: manufactures emulators
Date founded: 1988; Founded by: n/a
Current CEO: Roy K. McDonald
Current number of employees: n/a
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: Virtual PC and Connectix Virtual Game Station
Phone #: (800) 950-5880; (650) 571-5100
Street address: 2955 Campus Drive, San Mateo, CA 94403-2520
Fax #: (650) 571-0850
Web address: http://www.connectix.com
Comments: Connectix's Virtual Game Station lets Mac users run Sony PlayStation games; Sony is pursuing legal options to stop sales

D

Dell

Business description: produces and sells systems, hardware, and peripherals
Date founded: May 3, 1984; Founded by: Michael Dell
Current CEO/Chairperson: Michael Dell, 1984
Current number of employees: 26,100
Estimated revenues for last fiscal year: $19.9 billion
Market capitalization: $127 billion
Primary products: high-performance computer systems, desktop computers, notebook computers, network servers, workstation products, and storage products
Phone #: (800) 388-8542; (512) 338-4400
Street address: One Dell Way, Round Rock, TX 78682
Fax #: (800) 950-1329
Web address: http://www.dell.com
Comments: pioneer of the direct sales model and now one of the top computer manufacturers in the world

Diamond Multimedia

Business description: graphics and sound card manufacturer
Date founded: 1982; Founded by: n/a
Current CEO/Chairperson: William J. Schroeder
Current number of employees: 900
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: graphics cards, modems, wireless networks, audio cards, and wireless mice
Phone #: (800) 468-5846; (408) 325-7000
Street address: 2880 Junction Ave., San Jose, CA 95134-1922
Fax #: (408) 325-7070
Web address: http://www.diamondmm.com
Comments: Diamond specializes in 2D/3D graphics and sound accelerators

Dragon Systems

Business description: develops voice dictation software

Date founded: 1982; Founded by: Drs. Jim and Janet Baker
Current CEO/Chairperson: Janet M. Baker, 1982
Current number of employees: 325
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: Naturally Speaking and Point & Speak
Phone #: (800) 825-5897; (617) 965-5200
Street address: 320 Nevada St., Newton, MA 02160
Fax #: (617) 527-0372
Web address: http://www.dragonsys.com
Comments: Dragon Systems creates speech and language technology, including well-known, speech-recognition software

E

EarthLink Network

Business description: Internet service provider
Date founded: 1994; Founded by: Sky Dayton
Current CEO: Garry Betty, 1994
Current Chairperson: Sky Dayton, 1994
Current number of employees: 1,900
Estimated revenues for last fiscal year: $176 million
Market capitalization: $2 billion
Primary products: Internet service
Phone #: (800) 395-8410; (626) 296-2400
Street address: 3100 New York Drive, Pasadena, CA 91107
Fax #: (626) 296-2470
Web address: http://www.earthlink.com
Comments: EarthLink is a national Internet service provider and can offer access to people in places that lack local ISPs

Eastman Kodak Co.

Business description: manufactures imaging products for home and business
Date founded: 1892; Founded by: George Eastman
Current CEO/Chairperson: George Fisher, 1994
Current number of employees: 86,200
Estimated revenues for last fiscal year: $13.4 billion
Market capitalization: n/a
Primary products: printers, digital cameras, projectors, scanners, and multimedia software
Phone #: (800) 242-2424; (716) 724-4000
Street address: 343 State St., Rochester, NY 14650
Fax #: (716) 724-0663
Web address: http://www.kodak.com
Comments: Kodak is best known for its photography paper but now it makes digital cameras, projectors, printers, and multimedia software

Electronic Arts

Business description: produces entertainment software and computer accessories
Date founded: 1982; Founded by: Trip Hawkins
Current CEO/Chairperson: Lawrence F. Probst, III
Current number of employees: 2,523
Estimated revenues for last fiscal year: $909 million
Market capitalization: n/a
Primary products: Sid Meiers Alpha Centauri, Sid Meiers Gettysburg, Lost World, and game controllers
Phone #: (800) 245-4525; (650) 628-1500
Street address: 209 Redwood Shores Parkway, Redwood City, CA 94065
Fax #: (650) 628-1362
Web address: http://www.ea.com
Comments: an entertainment company that develops software for PCs and gaming consoles, such as the Sony PlayStation

emachines

Business description: manufacturer of low-priced PCs
Date founded: 1998; Founded by: Stephen A. Dukker, Korea Data Systems, and TriGem Computer
Current CEO/Chairperson: Stephen A. Dukker, 1998
Current number of employees: 35
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: etower computer systems and eview monitors
Phone #: (877) 566-3463
Street address: 14350 Myford Road, Irvine, CA 92606-1002
Fax #: (714) 505-5049
Web address: http://www.e4me.com
Comments: emachines, a joint venture between Korean PC manufacturer TriGem Computer, Inc. and monitor maker Korea Data Systems, captured buyers' attention with a sub-$500 PC

EPSON America Inc. (subsidiary of Seiko Epson)

Business description: produces imaging products for home or business
Date founded: 1975; Founded by: n/a
Current CEO: Norio Niwa, 1992
Current number of employees: n/a
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: printers, projectors, digital cameras, and scanners
Phone #: (800) 463-7766; (310) 782-0770
Street address: 20770 Madrona Ave., Torrance, CA 90509-2843
Fax #: (310) 782-5220
Web address: http://www.epson.com
Comments: EPSON is a leader in imaging products, manufacturing projectors, printers, and scanners

F

Fujitsu Computer Products of America

Business description: develops hardware peripherals and imaging solutions
Date founded: 1968; Founded by: n/a
Current CEO/Chairperson: Larry Sanders
Current number of employees: 700
Estimated revenues for last fiscal year: $1.2 billion
Market capitalization: n/a
Primary products: hard disks, tape and magneto-optical drives, scanners, and printers
Phone #: (800) 626-4686; (408) 432-6333
Street address: 2904 Orchard Parkway, San Jose, CA 95134-2009
Fax #: (408) 894-1709
Web address: http://www.fcpa.com
Comments: Fujitsu Computer Products of America markets a wide range of data storage and imaging solutions

G

Gateway

Business description: manufactures and sells PC desktops, notebooks, workstations, and accessories
Date founded: 1985; Founded by: Ted Waitt and Michael Hammond
Current CEO/Chairperson: Ted Waitt, 1985
Current number of employees: 19,000
Estimated revenues for last fiscal year: $7.5 billion
Market capitalization: $10.11 billion
Primary products: E-Series, GP Series, workstations, servers, and portables
Phone #: (800) 846-2000; (605) 232-2000

Street address: P.O. Box 2000, 610 Gateway Drive, North Sioux City, SD 57049
Fax #: (800) 846-4526
Web address: http://www.gateway.com
Comments: Gateway is a successful direct-sales PC company

Grolier Inc.

Business description: manufactures educational software
Date founded: 1895; Founded by: n/a
Current President: Brian Beckwith, 1998
Current number of employees: 1,500
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: multimedia encyclopedias and educational software
Phone #: (800) 621-1115; (203) 797-3500
Street address: 90 Sherman Turnpike, Dansbury, CT 06816
Fax #: (203) 797-3197
Web address: http://www.grolier.com
Comments: more than 100 years old, the company has changed with the times and now produces online and CD-ROM encyclopedias and educational software

H

Hasbro Interactive Inc.

Business description: designs, manufactures, and markets game software
Date founded: 1995; Founded by: Tom Dusenberry
Current CEO/Chairperson of Hasbro Inc.: Alan Hassenfeld
Current number of employees: 500
Reported revenues: n/a
Market capitalization: n/a
Primary products: Software games such as Frogger, Monopoly, Centipede, Hedz, and Roller Coaster Tycoon
Phone #: (978) 921-3700
Street address: 50 Dunham Road, Beverly, MA 01915
Fax #: (978) 921-3704
Web address: http://www.hasbro-interactive.com
Comments: PC Data has ranked Hasbro Interactive as one of the top-three entertainment software publishers

Hitachi

Business description: manufacturers software, DVD-ROM drives, projectors, and hard drives
Date founded: 1910; Founded by: n/a
Current CEO: Etsuhiko Shoyama, 1999
Current Chairperson: Tsutomu Kanai
Current number of employees: 330,000
Estimated revenues for last fiscal year: $8.4 billion
Market capitalization: $3.3 billion
Primary products: microprocessors, flash cards, DVD-ROM drives, hard drives, and projectors
Phone #: (800) 448-2244; (650) 589-8300
Street address: 2000 Sierrra Point Parkway, Hitachi Plaza, Brisbane, CA 94005
Fax #: (650) 583-4207
Web address: http://www.hitachi.com
Comments: Hitachi is a leader in global electronics and offers products such as imaging software, projectors, and monitors

I

IBM
(International Business Machines)

Business description: manufactures hardware for businesses and individual computer users
Date founded: 1911; Founded by: Thomas J. Watson, Sr.
Current CEO/Chairperson: Louis V. Gerstner, Jr., 1993
Current number of employees: 291,067
Reported revenues: $81.7 billion
Market capitalization: $169 billion
Primary products: portable computers such as the IBM PC Thinkpad, handheld PCs such as the IBM WorkPad, NT work stations such as the Intellistation, and Intel-based servers such as the Netfinity
Phone #: (800) 426-4968; (914) 499-1900
Street address: Old Orchard Road, Armonk, NY 10504
Fax #: (914) 499-4190
Web address: http://www.ibm.com
Comments: makes over 40,000 computer-related products

id Software

Business description: creates action gaming software with advanced, three-dimensional graphics
Date founded: 1991; Founded by: John Carmack, Adrian Carmack, and John Romero
Current CEO: Todd Hollenshead
Current Owners: John Carmack, Adrian Carmack, and Kevin Cloud, 1991
Current number of employees: 14
Reported revenues: n/a
Market capitalization: n/a
Primary products: games such as Doom, the Quake series, and Wolfstein 3-D
Phone #: (800) 434-2637; (972) 613-3589
Street address: 18601 LBJ Freeway, Suite 615, Mesquite, TX 75150
Fax #: (972) 686-9288
Web address: http://www.idsoftware.com
Comments: id games have found their way into movies such as "The Net," "Congo," and "Gross Point Blank;" and also into episodes of "Friends" and "ER"

Inprise Corp.
(formerly Borland International)

Business description: produces enterprise applications for businesses
Date founded: 1983; Founded by: Philippe Kahn
Current Interim CEO: Dale Fuller, 1999
Current Chairperson: William F. Miller, 1996
Current number of employees: 800
Reported revenues: $189 million
Market capitalization: $168 million
Primary products: software such as Borland J Builder, Borland Delphi, Borland C++ Builder, InterBase, Inprise Application Server, and VisiBroker
Phone #: (800) 233-2444; (831) 431-1000
Street address: 100 Enterprise Way, Scotts Valley, CA 95066
Fax #: (831) 431-4122
Web address: http://www.inprise.com; http://www.borland.com
Comments: the Borland JEDI Initiative retrieves code from Borland Web site visitors and Delphi CD users, creating resources for Delphi programmers

Intel Corp.

Business description: makes computer chips for most PCs
Date founded: 1968; Founded by: Robert Noyce, Andrew Grove, and Gordon Moore
Current CEO/President: Craig R. Barrett, 1998
Current Chairperson: Andrew S. Grove, 1997
Current number of employees: 64,500
Reported revenues: $26 million
Market capitalization: $207.9 billion
Primary products: processors, Intel 740 graphics chip, Express 3-D graphics card, and Strata Flash memory on the transistor
Phone #: (800) 538-3373; (503) 629-7354
Street address: 5200 N.E. Elam Young Parkway, Hillsboro, OR 97124-6497
Fax #: (800) 628-2283

Web address: http://www.intel.com
Comments: Intel's very first product was the 3101 Schottky 64-bit static random-access memory chip

Intergraph Corp.

Business description: manufacturer specializing in computer graphics systems, hardware for workstations and servers, and technology software applications
Date founded: 1969 ; Founded by: Jim Meadlock
Current CEO/Chairperson: Jim Meadlock, 1969
Current number of employees: 6,500
Reported revenues: $1,033 billion
Market capitalization on 12/31/1998: $279 million
Primary products: advanced 3-D workstations, PCs, monitors, graphics accelerators, and software
Phone #: (800) 345-4856; (256) 730-2000
Street address: One Madison Industrial Park, Huntsville, AL 35894
Fax #: n/a
Web address: http://www.intergraph.com
Comments: world's largest interactive computer graphics systems supplier company

Interplay Productions

Business description: publishes interactive entertainment software for PCs, Sony PlayStation, and Nintendo 64
Date founded: 1983; Founded by: Brian Fargo
Current CEO: Brian Fargo, 1983
Current number of employees: 410
Reported revenues: $126.8 million
Market capitalization on 06/01/1999: $55 million
Primary products: software such as Advanced Dungeons and Dragons, Forgotten Realms, Rogue Squadron game, Descent series, and Major League Baseball games
Phone #: (800) 468-3775; (949) 553-6655
Street address: 16815 Von Karman, Irvine, CA 92606
Fax #: n/a
Web address: http://www.interplay.com
Comments: sponsoring a $50,000 Descent 3 Tournament ending in August 1999

Intuit Inc.

Business description: creates desktop and Web-based financial programs that connect individuals to financial institutions
Date founded: 1983; Founded by: Scott Cook and Tom Proulx
Current CEO: Bill H. Harris, 1998
Current Chairperson: Bill V. Campbell, 1998
Current number of employees: 3,000
Reported revenues: $592 million
Market capitalization: $2.9 billion
Primary products: software such as Quicken and Quick Books and tax programs such as Turbo Tax
Phone #: (800) 446-8848; (650) 944-6000
Street address: 2535 Garcia Ave., Mountain View, CA 94043
Fax #: n/a
Web address: http://www.intuit.com
Comments: links almost one-fourth of online banking users in the United States to their financial institutions

Iomega

Business description: produces removable storage drives and disks
Date founded: 1980; Founded by: Antone Radman, Renee Radman, Dave Norton, Dave Bailey, and Rod Linton
Current CEO/President: Jodie K. Glore, 1998
Current number of employees: 4,500
Reported revenues: $1.7 billion
Market capitalization: $1.7 billion
Primary products: hardware such as Zip drives and disks, Jaz drives and disks, and Clik drives and disks
Phone #: (800) 777-4045; (801) 332-1000
Street address: 1821 W. Iomega Way, Roy, UT 84067
Fax #: (801) 778-3748
Web address: http://www.iomega.com
Comments: has established a strong market share in the war to replace the old 3.5-inch diskette

J

Jazz Speakers
(Jazz Hipster Corp.)

Business description: makes audio speakers for computers and electronics in partnership with Dolby, Microsoft, Intel, and other companies
Date founded: 1981; Founded by: Jazz Hsu
Current CEO: Jazz Hsu, 1981
Current number of employees: 500
Estimated revenues: n/a
Market capitalization: n/a
Primary products: J-2318 USB-powered speaker and J-4501 3-D speaker
Phone #: (800) 291-8999; (626) 336-2689
Street address: 1355 Darius Court, City of Industry, CA 91745
Fax #: (626) 336-2489
Web address: http://www.jazzspeakers.com
Comments: headquartered in Taipai, Taiwan

JVC Professional Products

Business description: manufactures digital accessories such as cameras, camcorders, VCRs, and graphics projectors
Date founded: n/a; Founded by: n/a
Current Executive VP/COO: Harry Elias, 1995
Current CEO/President: Katsukiko Hattori, 1995
Current number of employees: 400
Estimated revenues: n/a
Market capitalization: n/a
Primary products: hardware such as Digital S Camcorder, D-ILA Digital Graphics Projector, and Digital S Editor digital VCR
Phone #: (800) 526-5308; (973) 315-5000
Street address: 1700 Valley Road, Wayne, NJ 07470
Fax #: (973) 315-5030
Web address: http://www.jvcpro.com
Comments: America's Corporation is JVC's parent company, which is a subsidiary of the Victor Company of Japan

K

Kensington Technology Group

Business description: manufactures computer accessories
Date founded: 1981; Founded by: Phillip Damiano and Andrew Newmark
Current President: Peter DuPont
Current number of Fortune Brands employees: 26,000
Reported Fortune Brands revenues: $5.24 billion
Market capitalization for Fortune Brands on 06/01/99: $6.7 billion
Primary products: hardware such as Orbit USB Trackball mouse, Mouse-in-a-Box USB mouse, and Kensington Sports Contour wrist pads
Phone #: (800) 235-6708; (847) 541-9500
Street address: 2855 Campus Drive, San Mateo, CA 94403
Fax #: (847) 572-9675
Web address: http://www.kensington.com
Comments: a subsidiary of Fortune Brands

Kingston Technology Inc.

Business description: memory manufacturer
Date founded: 1987; Founded by: John Tu and David Sun

Current President: John Tu, 1987
Current VP Engineering: David Sun, 1987
Current number of employees: 1,000
Reported revenues: n/a
Market capitalization: n/a
Primary products: memory products for PCs, workstations, servers, printers, and laptops
Phone #: (800) 337-8410; (714) 435-2600
Street address: 17600 Newhope St., Fountain Valley, CA 92708
Fax #: (714) 435-2699
Web address: http://www.kingston.com
Comments: manufactures more than 2,000 memory products

L

Labtec Inc.

Business description: manufactures computer speakers, headphones, and accessories
Date founded: 1983; Founded by: Charles Dunn
Current CEO: Robert Wick
Current Co-chairpersons: Marc Leder and Rodger Krouse
Current number of employees: 100
Reported revenues: $64 million
Market capitalization: $37 million
Primary products: Studio Reference Series, Audio F/X Series, Space-Saver Audio Series, Spaceball 4000 FLX.
Phone #: (360) 896-2000
Street address: 1499 S.E. Technical Center Place Suite 350, Vancouver, WA 98683
Fax #: (360) 896-2020
Web address: http://www.labtec.com
Comments: Spaceball 4000 FLX is a 3-D motion control device where users push, pull, or twist a PowerSensor ball to maneuver through 3-D images

Lexis-Nexis

Business description: compiles information onto databases
Date founded: 1966; Founded by: n/a
Current CEO/President: Hans Gieskes
Current number of employees: 7,800
Reported revenues: $1.23 billion
Market capitalization: n/a
Primary products: databases available through an online service, CD-ROM, books, and the Internet
Phone #: (800) 227-4908; (937) 865-6800
Street address: P.O. Box 933, Dayton, OH 45401-0933
Fax #: (800) 348-2609
Web address: http://www.lexis-nexis.com
Comments: offers 2.3 billion documents online to 1.6 million subscribers in over 60 countries

Lexmark International Inc.

Business description: manufactures printers and supplies
Date founded: 1991, when it became independent from IBM; Founded by: n/a
Current CEO/Chairperson: Paul J. Curlander (CEO, 1998; chair, 1999)
Current number of employees: 8,000
Reported revenues: $3.02 billion
Market capitalization on 12/31/1999: $7.2 billion
Primary products: MarkNet network products and Lexmark 251 Color Jetprinter
Phone #: (800) 539-6275; (606) 232-2000
Street address: 740 New Circle Road N.W., Lexington, KY 40511
Fax #: (606) 232-2403
Web address: http://www.lexmark.com
Comments: prebate program lets printer users return empty printer cartridges for a discounted new cartridge

Logitech Inc.

Business description: manufactures interface devices
Date founded: 1981; Founded by: Pierluigi Zappacosta, Daniel Borel, and Giacomo Marini
Current CEO/President: Guerrino De Luca
Current Chairperson: Daniel Borel, 1981
Current number of employees: 3,100
Reported revenues: $390.2 million
Market capitalization: $260 million
Primary products: pointing devices, game controllers, keyboards, PC video cameras, and speakers
Phone #: (800) 231-7717; (510) 795-8500
Street address: 6505 Kaiser Drive, Fremont, CA 94555
Fax #: (510) 792-8901
Web address: http://www.logitech.com
Comments: world's largest mouse manufacturer has made almost 200 million mice

Lotus Development Corp.

Business description: software manufacturer
Date founded: 1982; Founded by: Mitch Kapor and Jonathan Sachs
Current CEO/President: Jeff P. Papows, 1996
Current number of employees: 8,000
Reported revenues: n/a
Market capitalization: n/a
Primary products: Lotus Notes R5 information management software, Lotus 1-2-3, C++ API interface, Domino Services
Phone #: (800) 343-5414; (617) 577-8500
Street address: 55 Cambridge Parkway, Cambridge, MA 02142-1295
Fax #: n/a
Web address: http://www.lotus.com
Comments: created the first on-screen help system, the first diskette with a tutorial, and the first PC customer support program

LucasArts Entertainment Co.

Business description: manufactures interactive games
Date founded: 1982; Founded by: George Lucas
Current President: Jack Sorensen, 1995
Current number of employees: 350
Reported revenues: n/a
Market capitalization: n/a
Primary products: Star Wars games and Indiana Jones games
Phone #: (888) 532-4263; (415) 472-3400
Street address: P.O. Box 10307, San Rafael, CA 94912
Fax #: n/a
Web address: http://www.lucasarts.com
Comments: just one of five Lucas Film companies governed by Lucas and board of directors: Lucas Film Ltd., Lucas Digital Ltd. LLC, Lucas Licensing Ltd., and Lucas Learning Ltd.

M

Macromedia

Business description: publishes entertainment and graphics software and devices
Date founded: 1992; Founded as a merger of Authorware and MacroMind Paracomp
Current CEO/Chairperson: Robert K. Burgess, 1996
Current number of employees: 500
Reported revenues: $150 million
Market capitalization: $1.8 billion
Primary products: Dreamweaver, Fireworks, shockwave.com, FreeHand, and Fontographer
Phone #: (800) 326-2128; (415) 252-2000
Street address: 600 Townsend St. Suite 310, San Francisco, CA 94103
Fax #: (415) 626-0554
Web address: http://www.macromedia.com
Comments: recently announced the shockwave.com entertainment site

MAG Innovision

Business description: manufactures professional and high-end graphics monitors
Date founded: 1989; Founded as a branch of MAG Technologies in Taiwan
Current CEO: James Liu, 1999
Current Chairperson: Edward Huang, 1994
Current number of employees: 139
Reported revenues: n/a
Market capitalization: n/a
Primary products: Value and Performance monitor series and General Usage monitor series
Phone #: (800) 827-3998; (949) 855-4930
Street address:
20 Goodyear, Irvine, CA, 92618-1813
Fax #: (949) 598-4929
Web address: http://www.maginnovision.com
Comments: introduced the JAG Control in 1996, a one-button user control that fine-tunes the monitor

Matrox

Business description: manufactures graphics cards, video tools, imaging hardware and software, and Internet access products
Date founded: 1976; Founded by: Lorne Trottier
Current CEO: Lorne Trottier, 1976
Current number of employees: 1,000
Reported revenues: n/a
Market capitalization: n/a
Primary products: Matrox video and editing cards
Phone #: (800) 361-4903; (514) 685-7230
Street address: 1055 St. Regis Blvd., Dorval, Quebec, Canada H9P 2T4
Fax #: (514) 685-7230
Web address: http://www.matrox.com
Comments: the Matrox DigiSuite LE editing card has 32-bit animated graphics and dual-streams of video

Maxtor Corp.

Business description: manufactures information storage products for desktops
Date founded: 1982; Founded by: James M. McCoy, Jack S. Swartz, and Ray Niedzwiecki
Current CEO/President: Mike Cannon, 1996
Current Chairperson: Dr. Chong Sup Park, 1998
Current number of employees: 5,600
Reported revenues: $2.4 billion
Market capitalization: n/a
Primary products: Diamond Max hard drives
Phone #: (800) 262-9867; (303) 678-2015
Street address:
510 Cottonwood Drive, Milpitas, CA 95035
Fax #: n/a
Web address: http://www.maxtor.com
Comments: distributes its products through over 2,000 retail outlets

Memorex

Business description: makes Memorex audio and video media products, computer accessories, and peripherals
Date parent company Memtek founded: 1993, which consolidated the various Memorex products
Current COO/President: Mike Golachinski, 1999
Current number of employees: 125
Reported revenues: n/a
Market capitalization: n/a
Primary products: CD-RW recordable CD drive, computer peripherals, and input devices
Phone #: (800) 636-8368; (562) 906-2800
Street address: 10100 Pioneer Blvd., Suite 110, Santa Fe Springs, CA 90670
Fax #: (562) 906-2877
Web address: http://www.memorex.com
Comments: Memtek has the rights to the well-known Memorex name

MetaCreations

Business description: creates visualization software for Web, graphics, and print application designers
Date founded: 1997; Founded as a merger of Meta Tools and Fractal Design
Current CEO/President: Gary L. Lauer, 1998
Current number of employees: 300
Reported revenues: $42.8 million
Market capitalization on 12/31/1998: $128,000
Primary products: Office Advantage, Bryce 4 3-D application, Painter 5.5 , Web Edition, and Soap 2 digital imaging program
Phone #: (800) 846-0111
Street address:
6303 Carpinteria Ave., Carpinteria, CA 93013
Fax #: (805) 566-6385
Web address: http://www.metacreations.com
Comments: Office Advantage lets you create presentations with 3-D graphs and voice tracks

Micrografx Inc.

Business description: manufactures enterprise graphics software
Date founded: 1982; Founded by: Paul Grayson
Current CEO: Douglas M. Richard, 1997
Current Chair: Russell E. Hogg, 1997
Current number of employees: 350
Reported revenues: $71.8 million
Market capitalization as of 12/27/1998: $107.2 million
Primary products: iGrafx system, Micrografx Flow Charts, Webtricity, and Network Charter
Phone #: (800) 664-6957; (972) 234-1769
Street address:
1303 E. Arapahoe Road, Richardson, TX 75081
Fax #: (972) 873-0906
Web address: http://www.micrografx.com
Comments: developed first application for the Microsoft Windows operating system in 1985

Micron Electronics

Business description: hardware and software manufacturer and marketer
Date founded: 1995; Founded as a merger of Micron Computer, Micron Custom Manufacturing Services, and ZEOS International
Current CEO/President: Joel Kocher, 1997
Current number of employees: 2,750
Reported revenues: $1.73 billion
Market capitalization: $1.3 billion
Primary products: manufactures desktops, notebooks, and accessories; markets other hardware such as Palm Pilots
Phone #: (888) 208-1937; (208) 898-3434
Street address:
900 E. Karcher Road, Nampa, ID 83687-3045
Fax #: (208) 876-9163 (West division); (800) 362-1205 (East division)
Web address: http://www.micronpc.com
Comments: achieved the International Organization for Standardization's elite 9001 registration for its commitment to process improvement

Microsoft Corp.

Business description: personal computer software designer
Date founded:
1975; Founded by: Bill Gates and Paul Allen
Current CEO/Chairperson: Bill Gates, 1975
Current number of employees: 27,000
Reported revenues: $14.48 million
Market capitalization on 12/31/1998: $348 billion
Primary products: software, Microsoft Windows, Microsoft Office; Services: Microsoft Network (MSN)
Phone #: (800) 426-9400; (425) 882-8080
Street address: One Microsoft Way, Redmond, WA 98052-6399
Fax #: (800) 936-4200 (desktop systems, products, and operating systems)

Web address: http://www.microsoft.com
Comments: Microsoft's ubiquitous products are available in 50 countries and 30 languages

Midwest Micro

Business description: hardware and software distributor and hardware manufacturer
Date founded: 1982; Founded by: Mark Runkle
Current CEO: Mark Runkle, 1982
Current President: Kent Markley, 1997
Current number of employees: 750
Reported revenues: $300 million
Market capitalization on 12/31/1998: $50 million
Primary products: BASICS PCs, printers, and computer peripherals
Phone #: (800) 626-0544; (937) 368-2309
Street address:
6910 St., U.S. Route 36 East, Fletcher, OH 45326
Fax #: (800) 562-6622
Web address: http://www.mwmicro.com
Comments: Systemax recently bought Midwest Micro

Mijenix

Business description: manufactures and develops software utility products for Windows operating systems
Date founded: 1993; Founded by: Mike and Jennifer Cronenberg
Current Board of Advisors CEO: Jennifer Cronenberg, 1993
Current CTO: Mike Cronenberg, 1993
Current number of employees: 30
Reported revenues: n/a
Market capitalization: n/a
Primary products: Fix-It Utilities 98, ZipMagic 98, PowerDesk Utilities 98, and FreeSpace
Phone #: (800) 645-3649; (303) 245-8000
Street address:
3030 Sterling Circle, Boulder, CO 80301
Fax #: (303) 245-8111
Web address: http://www.mijenix.com
Comments: founders created the name by taking the "Mi" in Mike, the "Jen" in Jennifer, and adding "ix" for the nine children they wanted to have (so far they have only two kids)

Mindscape Entertainment

Business description: develops, publishes, and distributes educational, entertainment, and information software
Date founded: n/a; Founded by: n/a
Current division head (of Mindscape and Broderbund): Gordon Landies
Current Chairperson (of Mattel): Jill Barad
Current number of employees for Broderbund and Mindscape: 550
Reported revenues: in 1998, The Learning Company, consisting of Broderbund, Mindscape, and TLC, made $850 million
Market capitalization: Mattel recently bought The Learning Company for $3.8 billion
Primary products: Imperialism II: Age of Exploration, Chessmaster, and Warhammer Universe
Phone #: (415) 895-2000
Street address:
88 Rowland Way, Novato, CA 94945
Fax #: (415) 895-2102
Web address: http://www.mindscape.com
Comments: Mindscape is now a division of Mattel

Mitsubishi Electronics America Inc. (MELA)

Business description: manufactures monitors, videoconferencing, time-lapse VCRs, printers, projectors, and thermal imagers
Date founded: 1977; Founded as a branch of Mitsubishi Electric Corporation in Japan
Current President/CEO of MELA: Kiyoshi Kawakami
Current Group President of Information Technologies Group and Executive VP of MELA: Takashi Miyata
Current number of employees: 628
Reported revenues: n/a
Market capitalization: n/a
Primary products: Diamond Plus, Diamond Scan, PrecisePoint, Diamond Pro, and MegaView color monitor series
Phone #: (800) 843-2515; (914) 925-3200
Street address: 5665 Plaza Drive, P.O. Box 6007, Cypress, CA 90630-0007
Fax #: (914) 921-2495; (914) 921-1695
Web address: http://www.mitsubishi-display.com
Comments: the Information Technologies Group manufactures display products and is a subsidiary of MELA

Mitsumi Electronics

Business description: manufactures computer peripherals (disk drives, keyboards, and mice)
Date parent company Mitsumi ElectricCompany founded: 1954; Founded by: Hajime Moribe
Current U.S. Vice President/General Manager: Tak Kumagai
Current CEO/President of Mitsumi Electric Company: Itsuo Moribe
Current number of employees: 33,000 in Mitsumi Electric Company
Reported revenues: $2.2 billion
Market capitalization: n/a
Primary products: KFK Series Keyboard, Slim Series Mouse, CD-ROM drives, floppy drives, CD-RW drives, and CD-R drives
Phone #: (800) 801-7927; (972) 550-7300
Street address:
5808 W. Campus Circle Drive, Irving, TX 75063
Fax #: (972) 550-7424
Web address: http://www.mitsumi.com
Comments: world's largest manufacturer of computer peripherals

Motorola Inc.

Business description: designs and manufactures integrated communications and electronics products
Date founded: 1928; Founded by: Paul V. and Joseph E. Galvin
Current CEO: Christopher B. Galvin, 1999
Current Chairperson: Gary L. Tooker, 1999
Current number of employees: 133,000
Reported revenues: $29.398 billion
Market capitalization: $36.6 billion
Primary products: software-enhanced cordless phones, satellite communications products and systems, networking and Internet-access products, embedded semi-conductor solutions, and electronic systems
Phone #: (800) 262-8509; (847) 576-5000
Street address: 1303 E. Algonquin Road, Schaumburg, IL 60196
Fax #: (800) 804-7353
Web address: http://www.mot.com
Comments: VoxML, a voice mark-up language to produce voice applications, has a Web server with voice applications written in VoxML that users can access

N

National Semiconductor

Business description: leading supplier of analog and mixed-signal integrated circuits for PC, communication, and industrial markets
Date founded: May 27, 1959; Founded by: Dr. Bernard J. Rothlein, Robert L. Hopkins, Robert Koch, Dr. Richard Rau, Dr. Milton Schneider, Dr. Edward N. Clarke, Joseph Gruber, and Arthur Seifert
Current CEO: Brian L. Halla, May 3, 1996
Current Chairperson: Brian L. Halla

Current number of employees: 11,000
Estimated revenues for last fiscal year: $2 billion
Market capitalization: $3.5 billion
Primary products: analog and mixed-signal integrated circuits
Phone #: (408) 721-5000
Street address: 2900 Semiconductor Drive, P.O. Box 58090, Santa Clara, CA 95052-8090
Fax #: (408) 739-9803
Web address: http://www.national.com
Comments: celebrated its 40th anniversary in May 1999

NCR

Business description: leader in ATMs, point-of-sale systems, and scalable data warehousing solutions
Date founded: 1884; Founded by: John Patterson
Current CEO: Lars Nyberg, 1995
Current Chairperson: Lars Nyberg
Current number of employees: 33,000
Estimated revenues for last fiscal year: $6.5 billion
Market capitalization: n/a
Primary products: data warehouses; point of sale terminals and store automation; automated teller machines (ATMs) and services to the banking and financial industry
Phone #: (937) 445-5000
Street address: 1700 S. Patterson Blvd., Dayton, OH 45479
Fax #: (937) 445-1893
Web address: http://www.ncr.com
Comments: signed a deal with 7-Eleven to provide a store information-system solution

NetManage Inc.

Business description: source for Web-to-host connections via Java or ActiveX and for server-based thin-client and thick-client software, connecting desktop PCs to UNIX and IBM AS/400 and mainframe computers
Date founded: 1990; Founded by: Zvi Alon
Current CEO/Chairperson: Zvi Alon, 1990
Current number of employees: 455
Estimated revenues for last fiscal year: $71 million
Market capitalization: $174 million
Primary products: PC Connectivity Solutions and Visual Connectivity Solutions
Phone #: (800) 558-7656; (408) 973-7171
Street address: 10725 N. De Anza Blvd., Cupertino, CA 95014
Fax #: (408) 257-6405
Web address: http://www.netmanage.com
Comments: launched new architecture for PC connectivity called eN2000

Netscape Communications

Business description: provider of software and services for businesses and consumers; makers of Netscape Communicator
Date founded: April 4, 1994; Founded by: Jim Clark and Marc Andreessen
Current CEO: n/a
Current Chairperson: n/a
Current number of employees: 2,000
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: Netscape Netcenter, Netscape Communicator, and E-commerce software
Phone #: (800) 638-7483; (650) 937-2600
Street address: 501 East Middlefield Road, Mountain View, CA 94043
Fax #: n/a
Web address: http://www.netscape.com
Comments: acquired by America Online

Nokia Display Products Inc.

Business description: designs and manufactures high-end computer monitors and flat panels displays for the corporate market
Date founded: started distributing Nokia Displays in the U.S. market in 1994 (Nokia Inc. founded in 1865); Founded by: n/a
Current President: Jim Cookson, March 1997
Current number of employees: 116 (North America)
Estimated revenues for last fiscal year (Nokia Inc.): $15.7 billion
Market capitalization: n/a
Primary products: 15-21-inch CRT monitors and 15- and 18-inch flat panel displays
Phone #: (800) 296-6542; (972) 894-5000
Street address: 6000 Connection Drive, Irving, TX 75039
Fax #: (972) 894-4113
Web address: http://www.nokia.com
Comments: opened new manufacturing plant in Reynosa, Mexico in 1999

NovaStor Corp.

Business description: offers line of data backup, synchronization and data interchange software products ranging from the desktop to enterprise network applications
Date founded: 1987; Founded by: Peter Means
Current CEO/Chairperson: Peter Means, 1987
Current number of employees: 30
Estimated revenues for last fiscal year: $5 million
Market capitalization: n/a
Primary products: data protection software
Phone #: (805) 579-6700
Street address: 80B West Cochran St., Simi Valley, CA 93065
Fax #: (805) 579-6700
Web address: http://www.novastor.com
Comments: recently announced NovaDisk SE backup software will be bundled with Intel motherboards

Novell Inc.

Business description: provider of directory-enabled networking software
Date founded: 1983; Founded by: Jack Davis and George Canova
Current CEO/Chairperson: Eric Schmidt, April 7, 1997
Current number of employees: 4,600
Estimated revenues for last fiscal year: $1.084 billion
Market capitalization: $8.2 billion
Primary products: Novell Directory Services, NetWare, GroupWise, ZENworks
Phone #: (800) 453-1267; (801) 222-6000
Street address: 122 East 1700 South, Provo, UT 84606-6194
Fax #: (801) 228-5077
Web address: http://www.novell.com
Comments: helped create the local-area network (LAN) market by delivering server operating system software for storing shared files and providing access to network printers

NVIDIA Corp.

Business description: designs, markets, and sells 3D processors
Date founded: January 1993; Founded by: Jen-Hsun Huang
Current CEO: Chris Malachowsky
Current Chairperson: Curtis Priem
Current number of employees: 300
Estimated revenues for last fiscal year: $158.2 million
Market capitalization: $529.4 million
Primary products: processors for graphics cards
Phone #: (408) 615-2500
Street address: 3535 Monroe St., Santa Clara, CA 95051
Fax #: (408) 615-2800
Web address: http://www.nvidia.com
Comments: recently release the RIVA TNT2 3D graphics processor

O

Okidata

Business description: supplier of PC peripheral equipment, including serial impact dot matrix printers, Digital LED page printers, and multifunction facsimile machines
Date founded: 1972; Founded by: joint venture between two Philadelphia entrepreneurs and Oki Electric
Current CEO: Dennis P. Flanagan, 1992
Current number of employees: 700
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: digital LED page printers, serial impact dot matrix printers, multifunction printers, and facsimile machines
Phone #: (800) 654-8326; (609) 235-2600
Street address: 2000 Bishops Gate Blvd., Mount Laurel, NJ 08054
Fax #: (609) 222-5320
Web address: http://www.okidata.com
Comments:
celebrated its 25th Anniversary in 1997

Oracle Corp.

Business description: database and ERP/CRM software, application server, consulting, and education and support services
Date founded: 1977; Founded by: Lawrence J. Ellison, Robert Miner, and Ed Oates
Current CEO/Chairperson:
Lawrence J. Ellison, 1977
Current number of employees: 43,800
Estimated revenues for last fiscal year:
$8.8 billion
Market capitalization: $47.413 billion
Primary products:
database and ERP/CRM software
Phone #: (800) 633-0596; (650) 506-7000
Street address: 500 Oracle Parkway, Redwood Shores, CA 94065
Fax #: (650) 506-7200
Web address: http://www.oracle.com
Comments: Oracle products run the top nine of 10 business-to-business E-commerce sites and 10 of 10 customer-to-business E-commerce sites

Origin Systems Inc.

Business description: developer of popular multiplayer online computer games
Date founded:
1983; Founded by: Richard, Robert, and Owen Garriott, and Charles Bueche
Current CEO: Jack Heistand, May 1999
Current Chairperson: Larry Probst
Current number of employees: 204
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: Ultima Online
Phone #: (800) 245-4525; (512) 434-4263
Street address:
5918 W. Courtyard Drive, Austin, TX 78730
Fax #: (512) 794-8959
Web address: http://www.origin.ea.com
Comments: Ultima Online launching in Europe in June; recently launched in Japan

P

Packard Bell NEC (PBNEC)

Business description: a leading producer of a broad range of desktop and mobile computers and servers
Date founded: 1986; Founded by: Beny Alagem
Current CEO/Chairperson:
Alain Couder, July 1998
Current number of employees: 3,000
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products:
Desktop and mobile computers and servers
Phone #: (916) 388-0101
Street address: 1 Packard Bell Way, Sacramento, CA 95828
Fax #: (916) 383-2134
Web address: http://www.packardbell.com (for Packard Bell products); http://www.nec-computers.com (for NEC products)
Comments: recently announced Urocket, an Internet service developed with Lycos and UUNet

Panasonic
(Matsushita Electric Corp. of America)

Business description: markets and manufactures electronics products
Date founded:
1959; Founded by: parent company, Matsushita Electric Industrial Co., Ltd. (MEI)
Current CEO/Chairman: Yoshinori Kobe
Current number of employees:
23,000 (North America)
Estimated revenues for last fiscal year:
$8.1 billion
Market capitalization: n/a
Primary products: consumer and professional electronics
Phone #: (201) 348-4000
Street address:
One Panasonic Way, Secaucus, NJ 07094
Fax #: n/a
Web address: http://www.panasonic.com
Comments: plans to market hard disc recorders by the end of 1999

Peachtree Software

Business description: leading developer of accounting solutions for small-to-medium-sized businesses
Date founded: 1976; Founded by: Ron Roberts, Ben Dyer, Steve Mann, and others
Current CEO: Ron Verni, July 1996
Current number of employees: 400
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: Peachtree Complete Accounting, Peachtree Accounting for Windows, and Peachtree 2000
Phone #: (800) 228-0068; (770) 724-4000
Street address:
1505 Pavilion Place, Norcross, GA 30093
Fax #: (770) 564-5800
Web address: http://www.peachtree.com
Comments: released Version 7 of Peachtree Complete Accounting and Peachtree Accounting for Windows

PhotoDisc Inc.

Business description: offers royalty-free stock photography, providing images to creative professionals in industries including graphic design, advertising, prepress, publishing, and web and multimedia design
Date founded: 1991; Founded by: Sally von Bargen, Mark Callaghan, Tom Hughes, Mark Torrance, and Chris Birkeland
Current CEO/President: Sally von Bargen
Current number of employees: 288
Estimated revenues for last fiscal year:
$57.7 million
Market capitalization: n/a
Primary products: individual images available in 150k, 600k, 10MB, and 28MB file sizes via the Web and CD-ROM collections
Phone #: (800) 528-3472; (206) 441-9355
Street address: 2013 Fourth Ave., Seattle, WA, 98121-2460
Fax #: (206) 441-9379
Web address: http://www.photodisc.com
Comments: offers many collections of digital images in categories such as fine art, object, designer tools, and animation

PNY Technologies

Business description: computer memory upgrades, processor upgrades targeted toward computer desktop systems, notebooks, servers, PDAs, printers, and digital cameras
Date founded: 1985; Founded by: Gadi Cohen
Current CEO/President: Gadi Cohen, 1985
Current number of employees: 400
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: memory modules, flash memory, and processor upgrades
Phone #: (800) 769-7079; (973) 515-9700
Street address: 299 Webro Road, Parsippany, NJ 07054
Fax #: (973) 560-5590
Web address: http://www.pny.com
Comments: second-largest memory manufacture in the United States

Pinnacle Systems Inc.

Business description: manufacturer of video editing equipment, character generators, special effects, and video servers
Date founded: 1986; Founded by: Ajay Chopra and Randi Moore
Current CEO: Mark Sanders
Current Chairperson: Ajay Chopra
Current number of employees: 450
Estimated revenues for fiscal 1998: $105 million
Market capitalization: $600 million
Primary products: Studio product line and DV and DC product line
Phone #: (650) 526-1600
Street address: 280 N. Bernardo Ave., Mt. View, CA 94043
Fax #: (650) 526-1601
Web address: http://www.pinnaclesys.com
Comments: received five Emmy awards for technical excellence and technical achievements

PSINet Inc.

Business description: offers a broad set of high-speed corporate local-area network connectivity services supporting managed security and guaranteed Internet, intranet, electronic commerce, Web hosting services, and services for other carriers and ISPs
Date founded: 1989; Founded by: William L. Schrader
Current CEO/Chairperson: William L. Schrader
Current number of employees: 2,000
Estimated revenues for last fiscal year: $259.6 million
Market capitalization: $2.8 billion
Primary products: corporate Internet access and private IP networks; Web and database hosting services; Electronic commerce solutions; Voice, fax, live audio-video, and other applications
Phone #: (800) 799-0675; (703) 904-4100
Street address: 510 Huntmar Park Drive, Herndon, VA 20170
Fax #: n/a
Web address: http://www.psinet.com
Comments: launched PSINet InterSky—a business-grade wireless Internet access service and a new DSL service in 1999; acquired naming rights to the Baltimore Raven's stadium and named it PSINet Stadium in 1999

Q

Quark Inc.

Business description: software development for publishing, workflow solutions, and content management
Date founded: 1981; Founded by: Tim Gill
Current CEO: Fred Ebrahimi, 1986
Current Chairperson: Tim Gill, 1981
Current number of employees: n/a
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: QuarkXPress and Quark Publishing System
Phone #: (800) 676-4575; (303) 894-8888
Street address: 1800 Grant St., Denver, CO 80203
Fax #: (303) 894-3399
Web address: http://www.quark.com
Comments: used in more than 100 countries to create, design, and manage the production of documents

R

Real 3D Inc.

Business description: technologies for 3D graphics rendering, image capture, and content creation
Date founded: 1997; Founded by: Lockheed Martin Corp.
Current CEO/Chairperson: Gerald W. Stanley, 1997
Current number of employees: 60
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: 3D graphics rendering and content creation/capture technology
Phone #: (407) 515-5000
Street address: 2603 Discovery Drive, Suite 100, Orlando, FL, 32826
Fax #: (407) 515-5397
Web address: http://www.real3d.com
Comments: recently added LINUX support to PRO-1000 family of image generators

RealNetworks

Business description: develops products and services for sending and receiving audio, video, and other multimedia services using the Web
Date founded: February 1994; Founded by: Rob Glaser
Current CEO/Chairperson: Rob Glaser
Current number of employees: 490
Estimated revenues for last fiscal year: $64.8 million
Market capitalization: n/a
Primary products: audio and video software products and services
Phone #: (800) 444-8011; (206) 674-2700
Street address: 2601 Elliott Ave., Seattle, WA 98121
Fax #: (206) 674-2699
Web address: http://www.real.com
Comments: RealNetworks launched RealJukebox in May 1999

S

Samsung Electronics America Inc. (SEA)

Business description: information systems (CRT & TFT monitors) and consumer electronics products
Date founded: 1978 (SEA); Founded by: n/a
Current President/CEO: Bo-Soon Song, February 1999 (SEA)
Current Chairperson: Jong-Yong Yun, January 1999 (SEC President)
Current number of employees: 340 (U.S.); 75,000 (worldwide)
Estimated revenues for last fiscal year: $13 Billion (SEC Worldwide)
Market capitalization: n/a
Primary products: CRT & TFT monitors and DVD players
Phone #: (800) 726-7864; (201) 229-4000
Street address: Samsung Information Systems Division, 85 West Tasman Drive, San Jose, CA 95134; Samsung Consumer Electronics Division, 105 Challenger Road, Ridgefield Park, NJ 07660
Fax #: (201) 229-4029
Web address: http://www.sosimple.com

Comments: recently launched flat screen CRT, Samsung's Infinetly Flat Tube display; launched HDTV and smart media card

Seagate Technology Inc.

Business description: manufacturer of disk drives, magnetic disks, and read-write heads
Date founded: November 1978; Founded by: Al Shugart and Finis Conner
Current CEO: Stephen J. Luczo, July 1998
Current Co-chairpersons:
Gary B. Filler and Larry Perlman, July 1998
Current number of employees: 84,000
Estimated revenues for last fiscal year:
$6.8 billion
Market capitalization: $7.3 billion
Primary products:
storage hardware and software
Phone #: (800) 732-4283; (831) 438-6550
Street address:
920 Disc Drive, Scotts Valley, CA 95066
Fax #: (831) 429-6356
Web address: http://www.seagate.com
Comments: recently shipped 2.5 millionth Cheetah 10,000-revolution-per-minute (rpm) hard drive

Sharp Electronics Corp.

Business Description: consumer electronics, business products, and electronic components
Date founded: 1962; Founded by: Subsidiary of Sharp Corp., which was founded by Tokuji Hayakawa
Current CEO: Toshiyuki Tajima, April 1999
Current Chairperson:
Toshiyuki Tajima, April 1999
Current number of employees: 3,100
Estimated revenues for last fiscal year:
$3.16 billion
Market capitalization: n/a
Primary products: notebook computers, network printers, personal digital assistants, and monitors
Phone #: (800) 237-4277; (201) 529-8200
Street address: Sharp Plaza, Mahwah, NJ 07430
Fax #: 201-529-8413
Web address: http://www.sharp-usa.com
Comments: recently introduced the Sharp Pro Series PG-D120 and PG-D210 portable LCD projectors

SIIG Inc.

Business description: computer upgrade manufacturer of I/O and EIDE/IDE, SCSI, USB devices, sound cards, video cards, input devices, power supplies, and accessories
Date founded: 1985; Founded by: Frank Liu
Current CEO/Chairperson: Frank Liu
Current number of employees: n/a
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: I/O boards and USB devices
Phone #: (510) 657-8688
Street address:
6078 Stewart Ave., Fremont, CA 94538
Fax #: (510) 657-5962
Web address: http://www.siig.com
Comments: recently launched a full line of USB products

SGI

Business description: manufacturers powerful servers, supercomputers, and visual workstations
Date founded: 1982; Founded by: Dr. James Clark and seven co-founders
Current CEO/Chairperson:
Richard E. Belluzzo, January 23, 1998
Current number of employees: 9,300
Estimated revenues for last fiscal year:
$3.1 billion
Market capitalization: $2.4 billion
Primary products: SGI Origin servers, Cray supercomputers, and Silicon Graphics O2 and Silicon Graphics Octane UNIX-based visual workstations
Phone #: (650) 960-1980
Street address:1600 Amphitheatre Parkway, Mountain View, CA 94043-1351
Fax #: (650) 933-0316
Web address: http://www.sgi.com
Comments: SGI is recognized as an industry leader in high-performance computing and visualization

Smart and Friendly Inc.

Business description: manufacturer of CD-Recordable, CD-ReWritable, CD-ROM, and optical storage technology
Date founded: 1982; Founded by: Perry Solomon
Current CEO: Perry Solomon, 1982
Current number of employees: 45
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: CD-Recorders, CD-ROM network servers, CD-ROM network towers, CD-ROM jukebox network towers, media, and accessories
Phone #: (818) 772-8001
Street address:
20520 Nordhoff St., Chatsworth, CA 91311
Fax #: (818) 772-2888
Web address:
http://www.smartandfriendly.com
Comments: Smart and Friendly President and CEO Perry Solomon was recently named to the Board of Directors of the Optical Storage Technology Association (OSTA)

Sony Electronics Inc. (SEL)

Business description: manufacturer and marketer of electronics products and services for consumer and professional markets
Date founded: 1946 (worldwide), 1960 (U.S.); Founded by: Masaru Ibuka and Akio Morita
Current CEO/COO: Dr. Teruaki Aoki, April 1998
Current Chairperson:
Howard Stringer, January 1998
Current number of employees: 25,000
Estimated revenues for last fiscal year:
$10.6 billion
Market capitalization: n/a
Primary products: personal and home a/v products, desktop and notebook PCs, computer components and peripherals
Phone #: (800) 222-7669; (408) 432-1600
Street address:
1 Sony Drive, Park Ridge, NJ 07656
Fax #: n/a
Web address: http://www.sel.sony.com
Comments: Sony's Walkman celebrates its 20th anniversary in 1999

Sun Microsystems

Business description: a leading provider of product, service, and support solutions for building and maintaining network computing environments
Date founded: February 1982; Founded by: Andreas Bechtolsheim, Vinod Khosla, Scott McNealy, and Bill Joy
Current CEO/Chairperson:
Scott McNealy, 1984
Current number of employees: 27,500
Estimated revenues for last fiscal year:
$2.936 billion
Market capitalization: n/a
Primary products: computer hardware, software, and services
Phone #: (800) 821-4643; (650) 960-1300
Street address:
901 San Antonio Road, Palo Alto, CA 94303
Fax #: (650) 786-8416
Web address: http://www.sun.com

Comments: Sun created several groundbreaking technologies including Java, JavaChip, Jini, Solaris, and Ultra Enterprise desktop workstations and servers

Symantec Corp.

Business description: utility software for business and personal computing
Date founded: 1982; Founded by: n/a
Current CEO/Chairperson: John Thompson, April 14, 1999
Current number of employees: 2,400
Estimated revenues for last fiscal year: $633 million
Market capitalization: n/a
Primary products: Norton Anti-Virus, Norton Utilities, and Norton SystemWorks
Phone #: (800) 441-7234; (408) 253-9600
Street address: 10201 Torre Ave., Cupertino, CA 95014
Fax #: (408) 864-2495
Web address: http://www.symantec.com
Comments: more than 50 million customers around the world use Symantec products

T

Texas Instruments

Business description: makes a variety of consumer electronics products
Date founded: 1930, as Geophysical Service; Founded by: J. Clarence Karcher and Eugene McDermott
Current CEO: Tom Engibous, 1996
Current Chairperson: Tom Engibous, 1998
Current number of employees: 19,000 (U.S.)
Estimated revenues for last fiscal year: $8.5 billion
Market capitalization: n/a
Primary products: semiconductors, personal organizers, digital signal processing solutions, and calculators
Phone #: (972) 995-2011
Street address: 8505 Forest Lane, Dallas, TX 75243
Fax #: n/a
Web address: http://www.ti.com
Comments: recently acquired Telogy Networks Inc.

V

ViewSonic Corp

Business description: worldwide provider of advanced technology display products, including high resolution computer monitors, digital and analog ViewPanel displays, and display projectors
Date founded: 1990; Founded by: James Chu
Current CEO/Chairperson: James Chu, 1990
Current number of employees: 705
Estimated revenues for last fiscal year: $941 million
Market capitalization: n/a
Primary products: CRT monitors, LCD displays, and projectors
Phone #: (800) 888-8583; (909) 444-8800
Street address: 381 Brea Canyon Road, Walnut, CA 91789
Fax #: (909) 468-3756
Web address: http://www.viewsonic.com
Comments: ViewSonic Display Technology products have won more than 525 awards from independent publications and organizations

Voyetra Turtle Beach Inc.

Business description: providers of multimedia music software and audio hardware
Date founded: 1975; Founded by: Carmine J. Bonanno
Current CEO: Carmine J. Bonanno, 1975
Current number of employees: 85
Estimated revenues for last fiscal year: n/a
Market capitalization: n/a
Primary products: Turtle Beach Montego II Quadzilla, Turtle Beach Montego II Home Studio, and Voyetra Hip Hop eJay
Phone #: (800) 233-9377; (914) 966-0600
Street address: 5 Odell Plaza, Yonkers, NY, 10701
Fax #: (914) 966-1102
Web address: http://www.voyetra-turtle-beach.com
Comments: recently released Montego II Quadzilla sound card

W

Western Digital Corp.

Business description: designs and manufactures hard drives for personal and enterprise-wide computing
Date founded: 1970; Founded by: Alvin B. Phillips
Current CEO/Chairperson: A. Haggery, 1993
Current number of employees: 10,000 worldwide
Estimated revenues for last fiscal year: $3.54 billion
Market capitalization: n/a
Primary products: hard drives
Phone #: (800) 832-4778; (949) 932-5000
Street address: 8105 Irvine Center Drive, Irvine, CA 92618
Fax #: n/a
Web address: http://www.westerndigital.com
Comments: supplies hard drives to world's leading PC manufacturers and to the consumer market through resellers

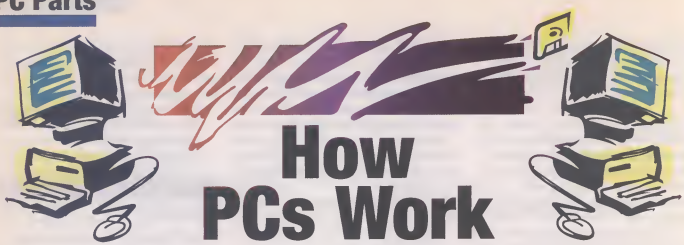
X

Xerox Corp.

Business description: document processing, products, systems, services, and solutions
Date founded: 1906; Founded by: The Haloid Company; named Xerox Corporation in 1961
Current CEO: G. Richard Thoman, 1999
Current Chairperson: Paul A. Allaire, 1991
Current number of employees: 92,700 (worldwide); 52,000 (U.S.)
Estimated revenues for last fiscal year: $19.4 billion
Market capitalization: n/a
Primary products: highlight color copiers/printers, multifunction devices, and inkjet and laser printers
Phone #: (800) 275-9376; (203) 968-3000
Street address: 800 Long Ridge Road, P.O. Box 1600, Stamford, CT 06904
Fax #: (619) 676-7710
Web address: http://www.xerox.com
Comments: Xerox and Fuji Xerox combined received more than 1,000 U.S. patents in 1998 (a Xerox record for any one-year period)

Xircom

Business description: leading manufacturer and OEM supplier of mobile communications solutions
Date founded: September 1988; Founded by: Dirk Gates
Current CEO: Dirk Gates, 1991
Current Chairperson: Dirk Gates, 1995
Current number of employees: 1,200
Estimated revenues for last fiscal year: $276 million
Market capitalization: n/a
Primary products: PC cards and CompactCards
Phone #: (800) 438-4526; (805) 376-9300
Street address: 2300 Corporate Center Drive, Thousand Oaks, CA 91320
Fax #: (805) 376-9311
Web address: http://www.xircom.com
Comments: Xircom says it created the "mobile networking" category in 1988 when it shipped the industry's first adapters for connecting notebook PCs to local-area networks



How PCs Work

Today's microcomputers are marvels of engineering. Only a generation ago, equivalent computers would have taken entire laboratory floors and armies of technicians just to keep running.

By comparison, the microcomputer's unassuming size and relative reliability can lull people into thinking of it as just another household appliance. While these electronic marvels deserve to become a home fixture, they are definitely more complex than the average blender. It would take volumes to completely explain how every component on a computer works, but here are some details about some of the more important parts of your PC.

■ **The Computer's "Brain"** In broadest terms, a computer is a system of physical parts (called hardware) that performs actions when it is given electronic instructions (called **software**). Sets of electronic instructions are called programs; they tell the computer how to do different things. If you think of software as music, then programs are particular songs, and computers are the instruments that play them. The more powerful the computer, the more complex the "songs" it can play, and the faster it can carry the tune.

The "brains" of the computer are **microprocessors**, matchbook-sized devices that process digital, or discrete, information. Microprocessors, which have names such as 486 and Pentium III, and are sometimes called **central processing units**, contain hundreds of thousands of electronic switches that can be turned "on" or "off" to represent 1s and 0s. Your PC uses combinations of these two electronic states to represent all data.

■ **Adding Your Input.** When you use a computer, you must tell it what to do. You give it instructions using input devices such as keyboards, mice, and microphones; the computer gives you results using output devices such as monitors, printers, or speakers. Each keyboard contains a microprocessor that is dedicated to the not-so-simple job of interpreting keyboard input. This microprocessor, called a **keyboard controller**, monitors the push-button switches hidden under the keyboard's keys. Each key press sends coded signals to the computer's microprocessor.

These keyboard signals are called **scan codes**. For instance, the scan code for a lowercase letter *a* is the hexadecimal number 1EH. To send the scan code for a capital *A*, the user can press the left SHIFT key (scan code 2AH) and then the letter *a*.

The keyboard controller can store a limited number of keystrokes, or scan codes, in a small amount of memory in the keyboard called a **type-ahead buffer**. This buffer stores scan codes until the computer is able to process them. You'll hear an angry chirping from the computer when the type-ahead buffer has been filled and the computer is unable to process these keystrokes.

No matter which input device you use, the information must be translated into a digital form before your computer can act on it. Input devices such as mice and joysticks translate a user's left-right and up-down hand motions into a corresponding action on the computer's display. Buttons associated with the input device can command programs to perform predetermined actions.

After you input data into the PC or retrieve it from storage on the hard drive or diskette drive, the computer temporarily holds the information in **random-access memory**, or **RAM**, chips. The PC moves data in and out of RAM as it processes it. Then it shows you the results, usually via the monitor.

■ **The Display.** A desktop computer's monitor is usually able to show program output in characters or in graphical output. The monitor performs its chores by turning tiny spots on the screen called **pixels** into a wide variety of colors. A 640-by-480 pixel (640 x 480) screen, for example, contains 307,200 pixels that can form detailed pictures. A pixel can change colors between 60 and 120 times a second. This is called the monitor's **scan rate** and is measured in **hertz**, the number of times the signal changes in one second. The higher a monitor's scan rate, the more steady and lifelike animation and video appear.

External devices, including keyboards and monitors, are connected to your computer with multipin connectors called **ports**. A mouse may use a PS/2 mouse port, a serial port, or a USB port. A joystick may plug into a sound card's joystick port or into a serial port.

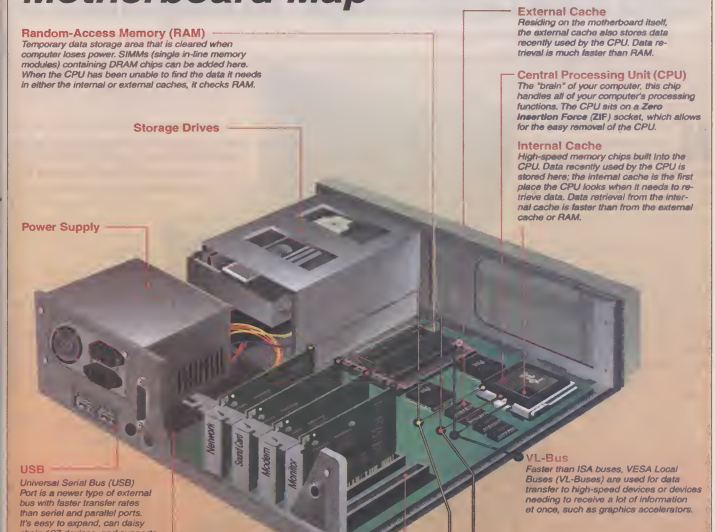
If you want to permanently store the information that appears on the monitor, you "save" the information. Usually that is done by storing the data magnetically on a diskette or on the hard drive contained in the system unit.

■ **Inside Details.** The **system unit**, which is the box portion of a computer, forms the soul of the PC. Electrical, electronic, and mechanical parts combine to create something new and different. The **power supply** converts alternating current (AC) power into direct current (DC) voltages used to power various devices and provide positive and negative logic signals for the system unit's **motherboard**, or main circuit board. (See figure at right.)

Circuit boards that plug into the motherboard are called **daughtercards**. In microcomputers, the daughtercards that users place into the computer are called **expansion cards**. Common expansion cards include sound boards and modems.

The microprocessor and its attendant chips located on the motherboard execute instructions contained in programs such as word

Motherboard Map


Random-Access Memory (RAM)
Temporary data storage area that is cleared when computer loses power. SIMMs (single in-line memory modules) containing DRAM chips can be added here. When the CPU has been unable to find the data it needs in either the internal or external caches, it checks RAM.
Storage Drives
Power Supply
External Cache
Residing on the motherboard itself, the external cache also stores data recently used by the CPU. Data retrieval is much faster than RAM.
Central Processing Unit (CPU)
The "brain" of your computer, this chip handles all of your computer's processing functions. The CPU sits on a Zero Insertion Force (ZIF) socket, which allows for the easy removal of the CPU.
Internal Cache
High-speed memory chips built into the CPU. Data recently used by the CPU is stored here; the internal cache is the first place the CPU looks when it needs to retrieve data. Data retrieval from the internal cache is faster than from the external cache or RAM.
Network
Sound Card
Modem
Monitor
USB
Universal Serial Bus (USB) Port is a newer type of external bus with faster transfer rates than serial and parallel ports. It's easy to expand, can daisy chain 127 devices, and supports Plug and Play and hot swapping.
VL-Bus
Faster than ISA buses, VESA Local Buses (VL-Buses) are used for data transfer to high-speed devices or devices needing to receive a lot of information at once, such as graphics accelerators.
Expansion Slot
ISA Bus
The oldest and cheapest bus type available. Industry Standard Architecture (ISA) buses are generally used for data transfer to slow devices, such as modems and sound cards.
Input/Output Ports
I/O Ports allow the computer to exchange data with external devices such as external modems or printers. Information travels to and from the serial and parallel ports much slower than it does inside the computer.
PCI Bus
Peripheral Component Interconnect (PCI) buses, although running at the same speed as VL-Bus, connect more devices and support the new Plug-and-Play standard. PCI buses are generally used for data transfer to such devices as network cards, SCSI adapters, and graphics accelerators.

processors and spreadsheets. Special electronic paths called **buses** route data and control signals between these chips and RAM and data storage devices such as hard drives, diskette drives, or compact disc, read-only memory (CD-ROM) drives. These buses are designed to simultaneously move groups of ones and zeros. In modern computers, 32 ones or zeros, called **bits**, can be moved at one time between the microprocessor and RAM. Data moving to some types of expansion cards and internal components is routed to 16-bit paths.

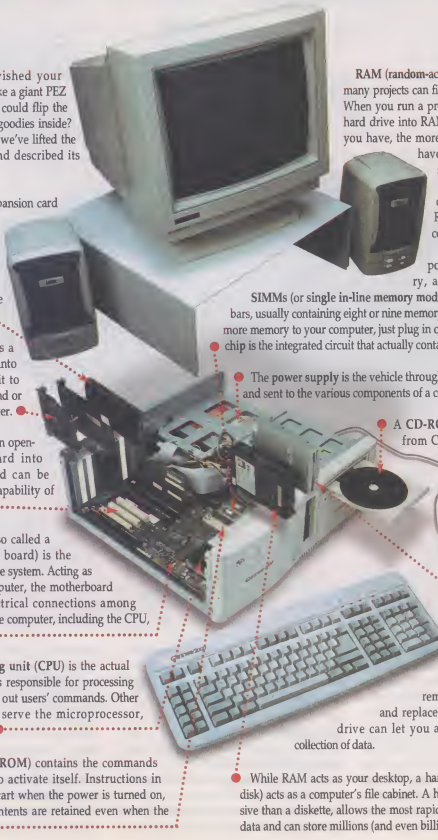
Low-level instructions for the computer's operation are contained in the computer's **read-only memory (ROM)** chips. These instructions form the **basic input output system (BIOS)**. Early computers could only upgrade BIOS by replacing the ROM chips. Now, BIOS chips can be updated from a diskette containing the new BIOS file.

Finally, an **operating system**, such as DOS or Windows 98, allows the computer to perform many complex tasks in support of programs running under the operating system's programming rules. Badly written operating systems can make the computer's components seem like junk, while a well-written operating system makes even slow machines seem snappy.

Computers are amazing technical achievements, but, as you can see, what they do isn't magic. They take input, work with it, and provide output. The individual operations they do are very simple, but they can do millions of them in the blink of an eye. It's this processing speed that makes computers such powerful tools. ■

The Parts Of Your Computer...

Have you ever wished your computer were like a giant PEZ dispenser so you could flip the top open and see all the goodies inside? To satisfy your curiosity, we've lifted the top off our computer and described its major parts.



A **sound card** is an expansion card that lets a computer produce sound. Examples of practical uses for sound capabilities include games, music applications, and interactive educational software.

The **expansion card** is a circuit board that slides into an expansion slot. Use it to add features, such as sound or a modem, to your computer.

An **expansion slot** is an opening on the motherboard into which a board or card can be placed, expanding the capability of the computer.

The **motherboard** (also called a system board or circuit board) is the most important part of the system. Acting as the foundation of a computer, the motherboard supplies all of the electrical connections among various components of the computer, including the CPU, ROM, and RAM.

The **central processing unit** (**CPU**) is the actual brain of a computer. It is responsible for processing instructions and carrying out users' commands. Other parts of the computer serve the microprocessor, enabling it to do its job.

Read-only memory (**ROM**) contains the commands your computer needs to activate itself. Instructions in ROM let the computer start when the power is turned on, and, unlike RAM, its contents are retained even when the power is off.

RAM (**random-access memory**) determines how many projects can fit on your desktop at one time. When you run a program, it is loaded from your hard drive into RAM. Ultimately, the more RAM you have, the more programs and files you can have open at once. Remember to save any work you intend to keep on a hard drive or diskette because whatever is in RAM gets erased when the computer is turned off.

RAM chips, the physical components that contain the memory, are grouped in rows called **SIMMs** (or **single in-line memory modules**). These modules are small bars, usually containing eight or nine memory chips. When you want to add more memory to your computer, just plug in one or more SIMMs. A **memory chip** is the integrated circuit that actually contains the RAM.

The **power supply** is the vehicle through which electricity is regulated and sent to the various components of a computer.

A **CD-ROM** drive reads information from CD-ROMs, the high-capacity medium used for most multimedia software. Digital Video Disc (DVD) drives, which read both CD-ROM and DVD discs, have begun to replace CD-ROM drives on newer systems.

The **diskette drive** reads and writes information on diskettes that usually hold 360,000 characters to 1,440,000 characters. Because you can remove diskettes from the drive and replace them with others, a diskette drive can let you access a virtually unlimited collection of data.

While RAM acts as your desktop, a **hard drive** (or hard disk or fixed disk) acts as a computer's file cabinet. A hard drive, though more expensive than a diskette, allows the most rapid access to your programs and data and can store millions (and even billions) of characters.

And How They Work Together

When you press a key on the keyboard, the information is not magically beamed to your monitor's screen. Your computer has more going on inside than the boxy beige exterior lets on. We've constructed a generic representation of how information travels through your computer. (Keep in mind some components may be positioned differently inside your own PC.)

Almost all signals, information, and functions travel through your computer's **microprocessor**, which is the brain of your computer. This chip also is called the **central processing unit** because this is where most of the processing takes place. The microprocessor depends on other components to perform many specialized functions. For instance, it needs **random-access memory** (**RAM**) as a temporary storage space to hold the programs and files with which it is working currently. The microprocessor also needs a **hard drive** or **diskettes** for permanent data storage, a **keyboard** for data entry, and a **monitor** to display the data. Other extras, such as **modems** and **sound cards**, let the computer exchange information over telephone lines or play music. ■

1 Let's start when you press the *M* key on the keyboard. When you depress the key, your keyboard uses its own microprocessor to pick up the signal and translate it into a language your system understands. The signal is transmitted to the PC via a cable that connects to a port on the back of the computer.

2 Inside your computer, the letter travels to the computer's microprocessor, which is a very busy chip. Before it can process the *M*, it first must finish processing data that was requested earlier. Thus, the *M* first travels to a RAM **buffer**, which is like a waiting room for information. The *M* shouldn't have to wait too long; keystrokes are assigned one of the highest processing priorities in your computer.

3 When the *M* reaches the microprocessor, the microprocessor translates the keystroke into information your monitor can understand. The microprocessor passes the signal on to the **video adapter card**, a circuit board that controls your monitor. The video card then passes the information along to the monitor, where the image is placed on the screen through a combination of blue, green, and red dots. Each red, blue, and green dot is known as a **pixel**.

4 What happens when you want to save that information (yellow line in diagram)? When you open the File menu and select the Save option, the software gets involved. The letters on-screen go to a buffer, and the software, which is temporarily stored in RAM, grabs the data in order to save it. The request then travels to the microprocessor, where the data is processed and passed to the hard drive. Inside the hard drive, a **read/write head** magnetically stores the information on **platters**, which look like miniature records.

5 All this happens at lightning-fast speed. The more powerful your hardware components, the faster data appears on-screen and files are saved.

The Parts Of A Portable

Portable computers contain the same types of components as their desktop cousins, but these components have been modified to pack everything into a smaller space. Although some portables are very powerful, usually top-of-the-line models are still slightly behind top-of-the-line desktop PCs in terms of processing power or storage capabilities. You'll also pay quite a bit more for a portable PC than a similarly equipped desktop system..

PCMCIA (Personal Computer Memory Card International Association) Card slots—A "plug-and-play" device that offers easy expansion for portable computers. PCMCIAs (or PC Cards) let users add memory, modems, radio transceivers, network adapters, solid state disks, and hard drives.

Diskette Drive—Reads information from and writes data to diskettes. As with CD-ROM drives, some portables use external diskette drives to cut down on weight.

Accelerated Graphics Port (AGP) Card—A 2X AGP card transfers graphic information at about 532 megabytes (MB) per second compared to older cards (266MB) and PCI graphics adapters (133MB). AGP lets textures run from system memory rather than local video memory, which frees the PCI bus from transferring video information.

LCD (Liquid-crystal Display)—The technology behind a portable's display screen. An LCD screen consists of rod-shaped crystals that move and bend light. The direction of these energized crystals creates a picture.

Digital Video Disc (DVD)—DVD drives read regular CD-ROMs in addition to the new DVD format. DVD discs hold around 4700MB (or 4.7 Gigabytes; GB) on each side compared to a standard CD-ROM (650MB). A second layer of information can be added to both sides of a DVD disc, holding as much as 17GB. Although CD-ROM drives are still standard on most laptops, you can upgrade to a DVD drive for a little extra.

Parts Of A Handheld Computer

Handheld computers are small and powerful, but not quite equal to laptop systems. These units use solid state technology to provide users with instant on/off functionality. Solid state technology means there are no moving parts. So what *is* inside a handheld device?

Processor—Usually some sort of **RISC (Reduced Instruction Set Computer)** based processor forms the heart of a handheld computer. These scaled down units can remain small and inexpensive by supporting fewer instructions than traditional desktop CPU's. Hitachi, NEC, and StrongARM all produce chips that support Windows CE. Occasionally, you'll have to download software that's designed to work with your system. If you have a RISC, or **MIPS (Microprocessor without Interlocked Pipeline Stages)** based processor, you may not be able to run software designed to run on a SH-3 processor.

Read Only Memory (ROM)—The operating system and any preloaded applications, such as Pocket Word, are contained in ROM. Unlike **ROM**, **RAM (Random Access Memory)**, which stores user applications and information (such as contacts, appointments, and voice recordings) is erased when there's a loss of power.

Touch Screen LCD Display—A touch screen lets users input information by tapping or drawing on the screen. Some handheld devices feature handwriting recognition programs. Most Windows CE devices display information in VGA resolution (640 pixels wide x 480 pixels high) and 256 colors.

PC Card Slot—a Type II PC Card slot lets users add memory, additional storage drives, or newer modems, etc.

Compact Flash—Lets users add additional memory.

Serial Cable Interface— Attaches to a serial cable for synchronizing and sharing data with a desktop computer.

Stylus—A pen like device used to input information on a handheld computer's touch screen.

IrDA Infrared Port—Lets users transfer information back and forth with other IrDA compatible devices..

Main Battery—Most contain Lithium-ion batteries, but some contain older Nickel-Metal Hydride batteries. You can recharge the main battery by plugging it into the AC adapter.

Backup Battery—Provides temporary power to the system's RAM if the main battery fails. □

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Get Connected

An Introduction To How Networking Works

In the span of a few short years, the Internet has permanently changed our civilization. School children now gaze at treasures in distant museums from their classroom computers while home users idly watch real-time video from rooftop cameras in cities a continent away.

At the heart of this change is the networked computer. Few PC users seem to really understand just how our globe-spanning networks work. Yet it is not too hard to learn if you take things a step at a time, beginning with some of the basic building blocks of networking.

■ **Linking Computers.** A computer **network** is a collection of two or more computers and associated devices linked together using some form of communications equipment. They are linked together so they can share software, hardware, and information. A group of network computers physically linked at the same location form a **local-area network (LAN)**. A group of LANs linked over a wide area, such as across a state, form a **wide-area network (WAN)**.

For the single home PC connected only with the Internet, the most obvious piece of communications equipment is the computer modem. Yet in settings where there are larger numbers of computers, such as banks, public utilities, and universities, PCs are linked together using network adapter cards, also known as **network interface cards (NICs)**. These adapter cards transfer data at rates much higher than those possible with conventional modems.

A sophisticated wiring and switching system connecting the network adapters helps route data from one computer to the next. The type of cabling you can use for networks is quite varied, ranging from simple telephone wire to coaxial cable to fiber optics cable. In addition to physical connections, a number of wireless communication schemes are in use, including infrared and radio frequency (RF) transmission.

■ **It's In The Cards.** Network devices must have some form of unique identification in order to tell each other apart. This is why NICs come with an unchangeable 12-digit hexadecimal address. This address is the physical address or more commonly the "burned-in" address. You may see the physical address referred to as a card's "BIA." (A **hexadecimal numbering system** is a base-16 numbering system that uses combinations of 16 digits to represent all numerical values. In addition to the 10 digits used in the familiar decimal system (0 to 9), hexadecimal numbering uses the letters A through F.)

Because humans don't usually think of long numbers as names, they can give a different name to each machine on the network. These names are known as machine names or logical names. Each machine name has to be unique, as well. For Microsoft networks, these names can be up to 15 characters long.

Once an NIC is in a PC, the operating system controls the NIC's electronic components through software **drivers**. The card manufacturer usually writes this software. While the software drivers link the card to the operating system, **network protocols** govern how computers communicate with each other.

In Microsoft operating systems, such as Windows 98 and Windows NT Workstation, the **NETBIOS extended user interface (NETBEUI)** protocol is used for small LANs. The NETBEUI supports network communications. In larger networks, the **Transmission Control Protocol/Internet Protocol (TCP/IP)** governs the communication in many LANs.

■ **Playing By The Rules.** Network protocols must work with a variety of operating systems and network hardware. The International Organization for Standardization (ISO) developed the **open system interconnection (OSI)** reference model to standardize how computers exchange data across a network. In this model, the network data moves up and down through seven layers.

At each layer, the network examines and processes the data according to the abilities of that particular layer. The network performs more and more complex tasks at each layer.

Physical layer. The first layer is the physical layer. All network data must enter and leave the PC through this layer. The physical layer represents the hardware connections where data moves in and out as a stream of binary data (ones and zeroes). This layer includes network cabling, the **connectors**, which link the cabling to the NIC, and the NIC.

Data link layer. Data from the physical layer moves to the data link layer where the network arranges the data into data frames. Data frames are packets of information transmitted as a single unit. (Depending on the type of network, these data frames may also be called network packets.) Each frame contains control information as well as the starting point and ending point of the unique information within the frame. This unique information is often referred to as the data frame's message. The NIC's software drivers operate in the data link layer.

Network layer. The network layer acts as the network's traffic cop, examining each data frame's control information to determine the frame's route to its destination. To do this, it has to be able to compare the logical network name in the control data to the physical address of the NIC. This layer is a very busy place in which frames are sent to their correct destination.

Transport layer. After leaving the network layer, data frames enter the transport layer. Here, the network examines data frames for errors and places them in the correct order without duplicate or missing frames. You can think of this layer as a train yard where the engineer puts all the boxcars in their proper order before the freight train leaves for its destination. This layer ensures complete data transmission.

Session layer. At the session layer, the network examines data frames to make sure they start, continue, and end a logical link between two computers. Using information from the data frames, the session layer determines which computer transmits or receives data and for how long.

Presentation layer. Next the network passes data frames to the presentation layer. At this layer, the network examines the message data and formats it accordingly. This includes character and number formatting for correct use at the next layer. The presentation layer is also responsible for data security and provides data encryption services.

Application layer. The final layer is the application layer. Here, the data frames are available to a user's applications, such as an E-mail program, a File Transfer Protocol (FTP) client, or an Internet browser.

It's important to remember that all network devices use the OSI reference model. This allows Windows PCs, Macintosh systems, and Unix workstations to all use the same protocols, such as TCP/IP, to share data. Network protocols generally do their business in the network, transport, and session layers.

Network protocols are responsible for transmitting and receiving network data, and assembling the data into a usable form for your computer's programs.

So, the rules laid down by the OSI reference model tell you: Network protocols are responsible for transmitting and receiving network data, and assembling the data into a usable form for your computer's programs.

■ **The Lay Of The LAN.** The design of a particular type of network is the network's topology, and wouldn't you know it, another organization is responsible for network topology standards. In February 1980, the Institute of Electrical and Electronic Engineers (IEEE) set up the 802 Project to develop LAN standards. The 802 Project set up standards for NICs and a variety of network components. For instance, you will find information about Ethernet networks in Project 802.3, Token Ring networks in Project 802.5, and network security in Project 802.10.

Ethernet is by far the most prevalent network topology. It was first developed in the 1976 at the Xerox Palo Alto Research Center, which is famous for many computer advances. Ethernet is a **baseband network**, which means all its network nodes have equal rights to transmit and receive data. Right now, Ethernet equipment can operate at either 10 megabits per second (Mbps) or 100Mbps. Technicians call the 100-megabit Ethernet **fast Ethernet**.

All Ethernet equipment uses the **collision sense multiple access/collision avoidance (CSMA/CD)** method. In this scheme, network adapters "listen" to the network to see if any other adapter is transmitting. If no other adapter is transmitting, then the listening network adapter is free to transmit.

To best understand how this works, let's imagine a very large family is having a Thanksgiving dinner together. Everyone is free to talk, and often people interrupt each other. When this happens, the pace of the family conversation slows down as the talkers pause to allow the other person to speak next.

This is exactly how CSMA/CD works for Ethernet networks. By now, you may suspect that if a large number of Ethernet adapters try to transmit at the same time, these adapters will also pause to allow other adapters to transmit. Actually, they all don't pause the same amount of time or they'd never be able to transmit their data. Nonetheless, as the Ethernet network gets busier, the average speed of the LAN gets slower. It's best to think of 10Mbps and 100Mbps as peak speeds for slow and fast-Ethernet networks, rather than as constant speeds.

■ **Ethernet Flavors.** Right now, there are three physical versions of Ethernet. These are known as 10Base-2, 10Base-5, and 10Base-T. This naming convention is pretty easy to break down. The 10 stands for 10Mbps. The term "Base" refers to the type of network. Ethernet, as you will remember, is a baseband network. And finally, the last digit identifies what type of connecting cable the network uses.

In **10Base-5** LANs, a half-inch (in diameter) coaxial cable connects network adapters up to 500 meters away. It is also know as **thicknet**

Ethernet because of the cable diameter. You can use 10Base-5 equipment to link to LANs separated by up to 500 meters. The 500 meter distance gives us the "5" in 10Base-5. When thicknet Ethernet acts in this capacity, it is acting as the network "backbone" because it is linking several distant LANs as part of a larger network.

The **10Base-2** LAN uses a thinner type of coaxial cable that is about a quarter-inch in diameter. It should not be too much of a surprise that it's also known as **thinnet Ethernet**. Its smaller size makes the cable more flexible and easier to thread behind furniture than the half-inch thicknet cable. The major trade-off is the maximum distance for the 10Base-2 LAN is only about 185 meters. This distance gives us the "2" in 10Base-2.

Both 10Base-2 and 10Base-5 are **bus-style networks** because the network cables are connected to each adapter from two directions, making a daisy chain. (A **daisy chain** is a set of hardware components that connect to each other in a series.) The end network adapters have to be terminated on one side with a **termination resistor**, which tells the network hardware where the ends of the LAN lie.

If a cable breaks or one of the termination resistors is not in place, all network traffic on the affected LAN ceases. Tracing down cable faults or bad adapters on a bus-style network is, in spite of their simple design, time consuming and tricky.

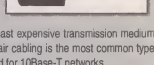
Fortunately, Ethernet equipment designers came up with a better Ethernet flavor known as 10Base-T. This type of card uses eight-conductor, telephone-style cables known as twisted-pair wire. This is where we get the "T" in 10Base-T. The maximum distance between two points on a 10Base-T network is about 100 meters.

In spite of the number of conductors, this is much smaller cabling that is much easier to thread through walls and behind furniture. Because it is standard telephone wire, trained wiring installation crews may only be as far away as you local phone company.

10Base-T network adapters are linked together using a **network hub**. Electrically, this connects all the network nodes together in a star pattern. This means that workstations at each point of the star can talk to any other workstation without having to pass through another workstation. This makes the 10Base-T network a better performer than the bus-style 10Base-5 and 10Base-2 networks. Also, a failure at any point of the star will not bring down the entire network.

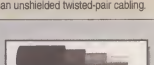
Network Connections

Unshielded Twisted-pair Cable



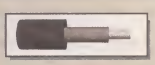
Made of two uninsulated, braided copper cables. Although the twisting of these individual pairs of cables minimizes electromagnetic interference, the lack of insulation makes the transmissions more susceptible to interference than shielded cable. Because this cabling is ordinary telephone wire, it's the least expensive transmission medium and is the easiest to install and work with. Unshielded twisted-pair cabling is the most common type of cabling used for local-area networks (LANs). It's generally used for 10Base-T networks.

Shielded Twisted-pair Cable



Also made of two braided copper cables, this version is insulated with a metallic braid or sheath to make it less susceptible to electromagnetic interference than unshielded twisted-pair cabling. This transmission medium provides better performance, but it is very expensive and is more difficult to work with than unshielded twisted-pair cabling.

Coaxial Cable

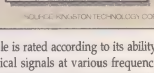


A wire conductor surrounded by a cylindrical conductor and either insulating rings or dielectric material, the entire cable is covered with a shield that blocks interference. Extremely durable, coaxial cabling lets users simultaneously transfer voice, data, and video signals. Available in thin (for 10Base-2 networks) and thick (for 10Base-5 networks) versions, thin coaxial is the most commonly used cabling. Providing more capacity than twisted-pair cabling, coaxial cable is also more expensive.

Fiber-optic Cable

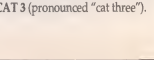
Made of three sections: the core (innermost layer consisting of at least one glass or plastic fiber); the cladding (glass or plastic coating with a different composition than that of the core); and the jacket (outer layer made of plastic and other materials to protect the cable from damage). Uses light to transfer voice, data, and video at high speeds. Commonly used for wide-area networks (WANs) because it can send data across longer distances and isn't affected by "cross-talk," or disturbances caused by radio waves. Still fairly new, fiber-optic cable is still too expensive to make it a feasible solution for home and small office networking needs.

RJ-45 Connector



Used in data transmissions across telephone wire, this eight-pin connector is used on 10Base-T networks using twisted-pair cabling. The wider end of the connector fits into the external end of a network card through the back of a computer's case.

BNC T-connector



A metal connector in the shape of the letter *T*. One end plugs into the external end of a network card on the back of a computer's case. The other ends form the top of the *T* and connect with network cables. This connector is used with coaxial cable on 10Base-2 networks.

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Generally speaking, you can connect 10Base-T workstations using standard **unshielded twisted-pair (UTP)** cable commonly used in telephone installation. However, this type of twisted wire cabling can accidentally pick up spurious electrical signals from radio frequency interference (RFI) produced by electric motors or noisy florescent light.

UTP cable is rated according to its ability to pass electrical signals at various frequencies. The Electronic Industries Association and the Telecommunications Industries Association (EIA/TIA) classify the rated speeds of twisted-pair cable. Cable that is certified to carry data communications at 10Mbps is rated as category 3 cable or **CAT 3** (pronounced "cat three").

You will need a more reliable type of twisted-pair cable to reach the 100Mbps speeds of fast Ethernet. Called **CAT 5 cable**, this type of UTP cable has more twists in it than CAT 3 cable. The extra twists help reduce the amount of electrical noise picked up by the cable. After CAT 5 cable is installed, special test equipment is used to check out (or certify) the cable as acceptable for higher-speed network traffic.

In areas where there is a lot of interference, **shielded twisted-pair wire (STP)** cable is best. This type of cable includes a metallic foil sheath that surrounds the wire pairs and conducts induced electrical signals away from the cable wires. Its nature also allows it to carry signals for longer distances. Naturally, it is more expensive than UTP cable.

■ **Linking LAN Segments.** If you are networking an office building, you may find that your proposed LAN may span several floors or cabling may have to go around a load-bearing wall. If you are building a 10Base-T network, you may find you can quickly extend your LAN past the 100-meter cabling limit.

When this happens, network technicians use a repeater to extend the maximum length. A **repeater** serves as a signal amplifier that takes a weakened signal and restores it to its original condition. Network technicians refer to this as **data regeneration**.

Certain networks, such as a 10Base-2 or 10Base-5 network, can also use repeaters to extend the number of computers in that network. In a 10Base-2 network, there can only be 30 computers per each 185-meter cable length. In a 10Base-5 network there can be up to 100 computers for each 500-meter cable length. By adding several repeaters, you can extend the number of computers in either type of network.

Because of Ethernet bus limitations, there is an upper limit to how many LAN segments you can link. The **5-4-3 rule** maximizes the number of computers on Ethernet bus networks. You can connect up to five LAN segments (using the maximum cable length) to four repeaters, allowing as many as three of the segments to have networked computers.

Therefore, a 10Base-2 network using the 5-4-3 rule can have 90 network nodes. A 10Base-5 network can have up to 300 network nodes. In contrast, the 10Base-T network that has to use network hubs to link network nodes together can have up to 1,024 network stations.

■ **Isolating LAN Segments.** As Ethernet networks grow, the speed at which data moves through the network can rapidly slow. To minimize this problem, network engineers use a **network bridge**. The network bridge only allows data destined for network nodes on its segment to cross the bridge from outside the segment. It also prevents data intended for network nodes on its segment from straying across the bridge in the rest of the network.

This makes for much better network performance. Network bridges operate on the data link layer of the OSI reference model and are able to pass non-routable network protocols such as NETBEUI.

The **network switch** is a newer network device that can also reduce network bottlenecks. It does so by very quickly linking two network nodes and then quickly linking another two nodes when the first connection is done. Network switches allow the creation of **Virtual Private Networks (VPN)** between network nodes. This is a much more secure method of communication and makes things much more difficult for the wily hacker. ■

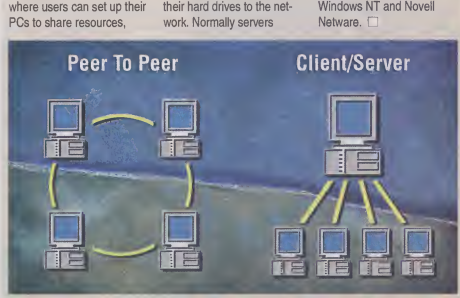
by Bill Hayes

Sharing Network Resources

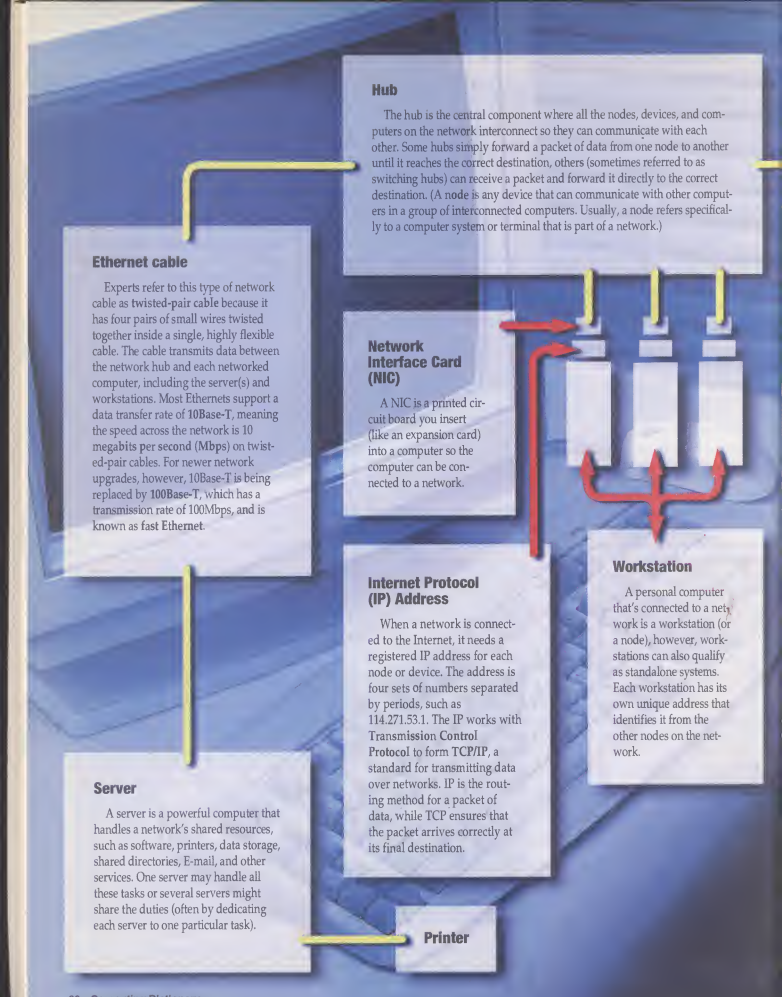
Windows-based PCs can operate either as part of a peer-to-peer network or as part of a Windows NT domain. **Peer-to-peer networks** are setup so the server is nondedicated, meaning it's also a workstation. Every computer in a peer-to-peer network acts on its own by storing files and accessing peripherals. This type of network works well on small LANs where users can set up their PCs to share resources, such as files, printers, or fax modems. In larger networks that ability begins to break down because there is not one central location for all the resources.

The **client/server network** model works well to handle this problem. Instead of scattering resources among a number of PCs, the resources are concentrated in servers. **Servers** are central PCs that move data from their hard drives to the network. Normally servers remain running at all times, making their resources available to anyone.

For security reasons, the client/server model requires user **authentication**. That means each person wanting to access server-based resources must have a valid user ID and password to access the network and certain resources. Examples of client/server network operating systems include Windows NT and Novell Netware. □



In a peer-to-peer network, all the computers have equal weight. In a client/server network, the server is the most powerful computer. Other computers, called clients, connect to the server so they can share its capabilities.


Hub
The hub is the central component where all the nodes, devices, and computers on the network interconnect so they can communicate with each other. Some hubs simply forward a packet of data from one node to another until it reaches the correct destination, others (sometimes referred to as switching hubs) can receive a packet and forward it directly to the correct destination. (A node is any device that can communicate with other computers in a group of interconnected computers. Usually, a node refers specifically to a computer system or terminal that is part of a network.)
Ethernet cable
Experts refer to this type of network cable as twisted-pair cable because it has four pairs of small wires twisted together inside a single, highly flexible cable. The cable transmits data between the network hub and each networked computer, including the server(s) and workstations. Most Ethernets support a data transfer rate of 10Base-T, meaning the speed across the network is 10 megabits per second (Mbps) on twisted-pair cables. For newer network upgrades, however, 10Base-T is being replaced by 100Base-T, which has a transmission rate of 100Mbps, and is known as fast Ethernet.
Network Interface Card (NIC)
A NIC is a printed circuit board you insert (like an expansion card) into a computer so the computer can be connected to a network.
Internet Protocol (IP) Address
When a network is connected to the Internet, it needs a registered IP address for each node or device. The address is four sets of numbers separated by periods, such as 114.271.53.1. The IP works with Transmission Control Protocol to form TCP/IP, a standard for transmitting data over networks. IP is the routing method for a packet of data, while TCP ensures that the packet arrives correctly at its final destination.
Workstation
A personal computer that's connected to a network is a workstation (or a node), however, workstations can also qualify as standalone systems. Each workstation has its own unique address that identifies it from the other nodes on the network.
Server
A server is a powerful computer that handles a network's shared resources, such as software, printers, data storage, shared directories, E-mail, and other services. One server may handle all these tasks or several servers might share the duties (often by dedicating each server to one particular task).
Printer

Firewall

A firewall, which can be either software or hardware, denies unauthorized users from accessing a network (usually via the Internet). For security reasons, all packets of data that are entering or leaving a network must first pass through the firewall. If a particular packet doesn't meet the set security standards, the firewall blocks that packet.

Router

A router is a device that connects two networks. It can also connect a network directly to an Internet service provider (ISP) for Internet access. Routers receive packets of data, filter them, and forward them to a final destination using the best possible route, sometimes traveling through multiple routers in the process.

Key Parts Of A Network

There's a good chance the office computer you use to access data and files, send E-mail, access the Internet, and print out reports is a small piece of a larger puzzle known as a **network**.

Whether it involves two computers connected by a cable, or hundreds of computers linked by telephone lines, networks are becoming increasingly popular in offices and homes. This is essentially due to the many enhancements networks provide, such as a more efficient work flow, better lines of communication, and the increased ease of sharing information and resources among users.

To illustrate the make up of a network designed for a small office, we've created a diagram consisting of the key components, including the hardware and software necessities. Put simply, networks let users work closer together by giving them the ability to easily share and transfer files and data.

Networks also save money by allowing users to share expensive peripherals (such as printers and scanners), as well as software applications. Networks usually are either a **local-area network (LAN)** or **wide-area network (WAN)**. LANs connect computers that reside in a smaller and confined area, such as within a home, office building, or large corporate room setting. Also, LANs primarily connect computers by using cables. Conversely, WANs connect computers across a much larger area, usually by utilizing telephone lines or satellites. LS

25 Frequently Asked Internet Questions

Information To Help You Become An Internet Guru

Much to the dismay of selfish computer users everywhere, the Internet is no longer a toy reserved solely for technologically inclined users. The old battle-hardened users talk about the good old days that predated the World Wide Web, before their inboxes and favorite newsgroups were clogged with spam. They remember a time when you could dial into the Internet and not have to worry about getting a busy signal. Regardless of whether the guru world is ready, the Internet is becoming mainstream. People who barely know how to turn on a computer are dialing in and logging on. Even if you've been online for a few years, odds are you probably have a few questions about how this grand network functions.

For those of you who don't know, a FAQ is a list of frequently asked questions. There is no surer way to draw the ire of an embittered guru than to ask a question that is covered in an FAQ (after all, the whole idea of a FAQ is so people can stop asking the most common questions). Before a guru with an attitude gets indignant with you for asking what bandwidth is, take a look at some of our most frequently asked questions about the Internet.

Internet Basics

The Internet is a complex network of computers from around the world that are linked together to share information. This section covers general Internet terms and questions dealing with items such as protocol and bandwidth.

Q Exactly what is dial-up networking and how does it work?

A **Dial-up networking** (**DUN**) is the primary method computer users employ to access the Internet, albeit not the only way. Dedicated high-speed connections are the most common methods used by businesses and Internet service providers. Some businesses, however, have high-speed access through T1 and T3 lines, but these lines are too costly for most consumers.

To use DUN, you need a **modem** (modulator/demodulator) and an account with an Internet service provider (see below). The modem translates the digital signals from your computer into analog signals your computer can send through standard telephone lines. The dial-up account from your service provider allows you to call a local **Point of Presence** (**PoP**). A PoP is simply a local computer that has a dedicated Internet connection.

(You dial into this instead of your service provider so you don't have to pay long-distance charges.) In the past, **shell accounts** gave users remote control of a service provider's computer and allowed them to remotely retrieve their E-mail messages and explore newsgroups from the service provider's computer. This only allowed users to view boring black text. Today, most dial-up accounts use **Point-To-Point Protocol** (**PPP**) connections that allow users to connect their computers directly to the Web. This allows users to take full advantage of what is available online. Users can experience colorful graphics and animation, as well as videos and sounds with this technology.

Dial-up accounts, however, may soon be as outdated as shell accounts if the new generation of dedicated Internet connection technology becomes popular. Many local telephone companies across the country are aggressively rolling out **Digital Subscriber Line** (**DSL**) technology. While the fastest modems connect at speeds approaching 50 kilobits per second (Kbps), DSL lines promise speeds of 384Kbps or faster depending on how much you're willing to spend and the exact type of DSL offered in your area.

Cable modems are the primary competitor for DSL. Although speeds can theoretically approach 10 megabits per second (**Mbps**, 10,000 Kbps) for cable modems, the average speed is much lower, but usually well above 1Mbps. Unfortunately, both telephone and cable companies must perform major upgrades to their internal networks before they can offer these technologies to their customers.

Q I keep getting busy signals when I try to sign on to the Internet. My friend says I should change ISPs. What's an ISP and how do I change it?

A An **Internet service provider** (**ISP**) provides a local PoP for consumers with dial-up Internet access in exchange for a monthly fee. No ISP has a modem for every customer because not every customer is going to be online at any one time. If, however, you're getting a lot of busy signals, especially in the evenings when traffic is highest, then your ISP probably doesn't have enough modems to support the demand in your area. Changing to a different ISP may help, but you certainly don't want to change your ISP and then find out your new ISP is just as bad.

Before signing up with an ISP, ask what its modem-to-user ratio is. Look for a ratio of about 9-to-1 to ensure as few busy signals as possible. The ultimate test for any ISP, however, is to actually try it and see how it performs. Occasionally, an ISP may provide the first month free to new users. This free month not only allows you to evaluate your new ISP's service but it also allows you time to ensure that all your friends and family have your new E-mail address before you cancel your old account.

You will also want to double-check to make sure your new ISP has a local PoP (dial-in number). Long distance fees will apply if you have to dial in to a computer outside your local calling area. If you live in a rural community, you may only have one or two ISPs from which to choose. On the other hand, if you live in a metropolitan area, you may have your choice of several ISPs. If you're lucky enough to have cable modem access, you'll *have* to use the ISP your cable company uses. (Connection with cable modems, however, are full-time. This means you will never have to worry about busy signals.)

Most local telephone companies provide Internet service. Look in your telephone book for more information about Internet access. If you want to go with a national ISP, find out what extra services, such as space for a personal Web site, extra E-mail addresses, virtual domain names, and other miscellaneous services, each one provides. Also, make sure your ISP will provide you with the services you'll need as your Internet knowledge grows.

Most Internet services charge close to $20 for unlimited monthly Internet access. If you don't spend much time online, you might be able to find cheaper plans that limit the number of hours you can spend online. The ISP may charge you an additional fee, however, if you exceed your limit.

Popular national ISPs include Netcom (http://www.netcom.com), Mindspring (http://www.mindspring.net), AT&T WorldNet (http://www.att.net), and Concentric (http://www.concentric.net). What about America Online (AOL, http://www.aol .com)? Well, AOL is not technically a service provider. It does provide access to the Internet, but its exclusive content makes it more of an online service. An **online service** provides additional content to customers in addition to Internet content. An AOL member has access to the Web as well as AOL chats, forums, and special content. An ISP customer may have access to the Web, but he or she will not have access to exclusive content from the ISP.

Q I keep seeing references to servers and clients. What exactly are servers and clients?

A The server/client relationship is the relationship that makes the Web go round. If you don't already know the difference between servers and clients, then you're probably using a client. **Clients** are computers that request information from a server; the **server** is a computer that delivers the information to the client. When you request information, your computer sends a request to a computer running the correct server software. For example, if you're requesting a Web page, the server must be running Web server software. The software responds to your request by finding the information you requested and sending the information directly back to your computer. Your client software displays the information you receive.

Q How do Internet addresses work?

A It's just common sense that every computer on the Internet must have its own unique address. The address we most commonly interact with is a computer's domain name, such as smartcomputing.com. A domain name is the identity title given to a system of computers, usually including the top domain and its subdomains. The primary or top-level domain is the suffix, in most cases a .com. It usually indicates the type of organization. Other top-level domains include .net and .org. Often, foreign countries use the top-level domain to specify their geographic region. The United Kingdom, for example, uses .uk as its top-level domain. The second-level domain in the above example would be smartcomputing. The www part of an address specifies that it is a World Wide Web page. The entire address, www .smartcomputing.com, is a fully qualified domain name.

All companies, organizations, and individuals must register their domain names with a firm accredited by Internet Corp. for Assigned Names and Numbers (ICANN). Network Solutions (http://www.networksolutions.com) is the primary company in the United States handling domain name registration. It will cost you $129 to register a

domain name for two years through Network Solutions. New competition from companies such as Register.com (http://www.register.com), however, is forcing prices down. Register.com allows you to register a domain name for two years for $70.

The Internet, however, does not use domain names to identify computers; it translates domain names into **Internet Protocol (IP) addresses.** An IP address includes four segments of numbers that are each up to three digits long. Decimal points separate the four segments. The IP address for smartcomputing.com is 204.96.107.152.

Domain name servers (DNSes), which are services with central computers to which all other computers on the Internet ultimately link, try to connect domain names with IP addresses by searching their databases of registered domain names. When a user requests a certain Web page, for example, a DNS will search for a match. Once it finds a match, it will translate the domain name into an IP address and then forward the request to the correct computer.

You do not need a domain name, however, to have an IP address. If you have a dial-in account, your ISP assigns your computer an IP address every time you dial in to one of its computers. It's nearly impossible to receive the same IP address every time you log on. For a home client, this dynamic IP assignment is actually a good security precaution. For those trying to serve information on the Internet, however, you need a dedicated connection with a static, or unchanging, IP address. It's also a good idea to register a domain name so users don't have to try to remember a long IP address.

Q What is TCP/IP?

A **Transmission Control Protocol/Internet Protocol (TCP/IP)** refers to a suite of protocols that, together, help to move information on the Internet. This suite often works with protocols such as **Hypertext Transfer Protocol (HTTP,** a protocol for moving Web pages over the Internet), **File Transfer Protocol (FTP,** allows user to exchange files over the Internet), and **Simple Mail Transfer Protocol (SMTP,** allows users to send E-mail messages). The actual TCP/IP protocols are two separate protocols that run together.

The Internet Protocol (IP) portion of the standard dictates how packets of information are sent out over networks. IP has a packet-addressing method that lets any computer on the Internet forward a packet to another computer that is a step (or more) closer to the packet's recipient.

The Transmission Control Protocol (TCP) portion ensures the reliability of data transmissions across Internet-connected networks. TCP checks packets for errors and submits requests for retransmissions if it finds errors; it will also return the multiple packets of a message into the proper, original sequence when the message reaches its destination. TCP/IP has become the standard protocol suite for transferring information along the Internet and many other smaller networks.

Q I keep hearing all this talk about bandwidth. What exactly is it?

A **Bandwidth** is a tricky term to define because it's used in so many different ways. Bandwidth is used primarily as a measure of data transfer speeds or as a measure of space available for data to occupy.

Data transfer speeds. When talking about the speed of data transfer, bandwidth relates to the amount of information that is moved in a set amount of time. Usually, this is expressed as bits per second (bps) or **kilobits per second (Kbps,** there are 1000 bits in a kilobit). Therefore, a 14.4Kbps connection takes twice as long to download a picture as a 28.8Kbps connection. We would say that the 28.8Kbps connection has twice the bandwidth of the 14.4Kbps connection.

New broadband technologies such as DSL and cable modems promise to deliver a fat bandwidth pipe to the home to increase data transfer speeds. As the pipe fattens, we'll begin to fit everything through it. Voice for telephone, video and sound for television, and data from the Internet may all eventually flow easily through one giant bandwidth pipe. For now, however, what we have—which, for many of us, is a modem connection with little bandwidth—limits us.

Anyone who maintains a commercial Web site through an ISP is aware of bandwidth restrictions placed on his or her Web page. In this context, the ISP allows other users to download a certain number of bits per month. If you have a popular site and exceed the bandwidth limit, the ISP charges you for the additional bits your visitors request. This is the same basic definition as above (a measure of the amount of data moved over a given period), but by lengthening the period of time to a month, ISPs can use this as a measure of traffic.

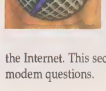
Available space. Usenet (a giant bulletin board on the Internet consisting of user news, E-mail, and forums on specific topics) users often complain of wasted bandwidth by off-topic posts. In this context, bandwidth does not relate to speed as much as it does to size constraints. Each newsgroup has a set amount of space on each news server. That means that every flame war (argumentative newsgroup postings) and get-rich-quick scheme pushes an old, potentially useful post off the server.

This also goes for personal Web sites. Many ISPs only allow users a certain amount of space for their Web sites. So, if a user has a one-page site with many high-resolution graphics, his or her site will take up more space than a user with a one-page site full of only text.

Q I have an old 486 computer. Can I get on the Internet with it?

A If you have a modem and a service provider, there should be no problem. Your modem speed and operating system are more important than processing power for going online. Windows 95 (Win95) will run on a 486 if you have enough memory (going beyond the recommended amount of memory will increase performance). Win95 might run a little slower than Windows 3.1, but it'll be worth the performance hit for its included dial-up networking support.

Of course, if you find Win95 to be too slow, you could buy a new computer. With prices falling on powerful systems, it might be a good time to get out from under that old 486 and into a sleek new machine. Don't short that old 486, though. It can still give you hours of online bliss.



Modems

Modems connect to your computer either internally or externally and are used for sending information back and forth along the Internet. This section will answer all your modem questions.

Q What type of modem is best for me? What are PC Card modems?

A There are three "body" styles for modems: internal, external, and PC Card. All three types of modems perform the same way and have the same capabilities. Most modems for desktop computers are either **internal modems**, circuit boards inside your computers, or **external modems**, separate pieces of hardware that connect to the outside of computers with cables. You will usually find **PC Card modems** (credit card-sized modems) on laptop computers, although you may find them on some desktop computers. These modems plug into a **PC Card slot**, which is a small opening in the computer.

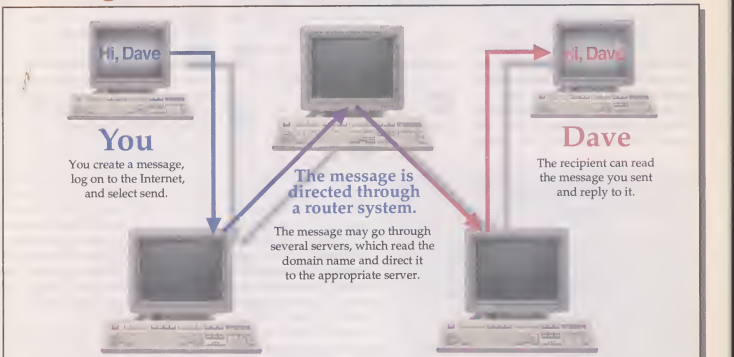
If your deskspace is already at a minimum, you will probably want an internal modem. If you have extra space and don't want to install an internal modem, you will probably want an external modem, which is about the size of a portable CD player. Although portable computers can also use these types of modems, many systems now use PC Card modems. These devices are light, easy to install, and take up minimal space.

Q Do I need to upgrade to a V.90 modem?

A V.90 is the modem standard for 56Kbps modems. This standard is a mix of the old K56flex standard and the x2 standard. All new 56Kbps modems now adhere to the new standard. If, however, you bought your 56Kbps modem before the standard was official, you will want to upgrade to the new standard. You

Sending Electronic Mail

Just like traditional postal messages, or "snail mail," E-mail takes an indirect route from sender to recipient.


Hi, Dave
You
You create a message, log on to the Internet, and select send.
The message is directed through a router system.
The message may go through several servers, which read the domain name and direct it to the appropriate server.
Hi, Dave
Dave
The recipient can read the message you sent and reply to it.
Your ISP's mail server
The message goes to the Internet service provider's (ISP) mail server, which then sends it to the recipient's mail server.
Recipient ISP's mail server
The message sits in the recipient's mail server until he calls in, checks his mail, and downloads the messages to his computer.

What's In A Name?

Each E-mail address you send is made up of certain components that help route it to the proper recipient, just like a mail address on an envelope.

74644.3017@compuserve.com

- **74644.3017** — User name or identification number.
- **@** — The At sign serves as a divider between E-mail sections.
- **compuserve.com** — Domain name, which is the name of the user's Internet system or location.

should be able to obtain free upgrade software from your modem's manufacturer. Before you will get full functionality from your V.90 modem, however, your ISP will have to upgrade its modems. (Most national ISPs have already been upgraded.)

Q I have a 56Kbps modem but have never connected at 56Kbps. What gives?

A Modem manufacturers are notorious for playing the naming game. The truth of the matter is that numerous variables go into determining a connection speed. Your modem and your computer are just a part of the big picture. The quality of your local telephone lines and the modem on the other end are big determinates for connection speed. When 33.6Kbps modems first hit the market, few people were able to connect at 33.6Kbps because of poor telephone lines and outdated modems on the service provider's end.

You've probably noticed this if you have a 56Kbps modem. Sometimes you might connect at 49333bps, while other times it might be 50000bps. But you've never seen a true 56Kbps connection. You are not alone. No one has ever seen a 56Kbps connection (outside of a lab) because the Federal Communications Commission (FCC) restrains the maximum connection speed of modems to 53Kbps.

The World Wide Web

Believe it or not, the Internet existed before the introduction of the World Wide Web. Since its public introduction in 1991, however, the Web has exploded and helped to launch the Internet into mainstream culture. Here is everything you need to know to feel comfortable using the Web—because once you start surfing, you won't want to stop.

Q What do I need to use the World Wide Web?

A Anyone with a dial-up Internet connection that supports PPP can get on the Web. You will need a piece of software known as a Web browser to view Web pages. Web browsers are free to download and you probably already have one on your system if you're running Win95 or higher. Microsoft Internet Explorer and Netscape Navigator are the most popular Web browsers.

Q What is HTML?

A **Hypertext Markup Language (HTML)** is a language used to provide instructions for formatting World Wide Web pages. HTML uses tags to define how text and graphics should appear and to provide **hyperlinks**, (icons, graphics, or words that, when clicked with the mouse, automatically open another file) which allow users to access information in other segments, pages, or Web sites. Tags usually come in pairs, with one instance activating the command and the second instance deactivating the command. Any text entered between the two commands will display accordingly. In the Internet Explorer Web browser, you can view the HTML source of any Web page by selecting View from the pull-down menu and clicking Source.

Simple HTML is easy to use and provides general control over formatting, image placement, color of text and background, and hyperlinks to other information on your Web site or other Web sites. More advanced features require a great deal more time and study.

Q What are search engines?

A **Search engines** are programs that allow users to locate specified information from a database or mass of data. Search engine sites are popular on the Web because they allow users to quickly sift through millions of documents on the Internet.

For example, if you wanted to see what types of sites the Internet has to offer on basketball, you might visit the Yahoo! site (http://www.yahoo.com). Once you're there, you simply type **basketball** in the search window, and away you go. Your request for sites about basketball should bring back a list of possible sites. If they're not exactly what you were looking for, you might try to narrow your search parameters; most search engines make it easy to do.

Each search engine's automated program conducts searches in its own way, and this appears to be an area of much debate among the various companies, with each contending that their program is the best. In the end, it probably doesn't really matter exactly how each service gathers its information, as long as it's correct and comprehensive and you can find what you're looking for when you use it.

E-mail

E-mail has been dubbed the "killer app" of the Internet because it's one of the biggest attractions for online users. The ability to send fast, free messages to any other E-mail address in the world has made E-mail

The 10 Most Popular Search Engines

Let's face it, searching for information online isn't easy. Sometimes finding exactly what you want is like trying to find a grain of sugar in a bowl of salt. We're not saying these search engines are going to help you find what you need any faster, but these are the sites that people seem to be using. According to Nielson/NetRatings (http://www.nielsen-netratings.com), Yahoo! was the most visited site on the World Wide Web during the month of April in 1999.

1. Yahoo!
   http://www.yahoo.com
2. Microsoft Network
   http://www.msn.com
3. The Go Network/Infoseek
   http://www.go.com
   http://www.infoseek.com
4. Netscape
   http://www.netscape.com
5. Lycos
   http://www.lycos.com
6. Excite
   http://www.excite.com
7. AltaVista
   http://www.altavista.com
8. HotBot
   http://www.hotbot.com
9. Looksmart
   http://www.looksmart.com
10. WebCrawler
    http://www.webcrawler.com

one of the most important communications tools in use today. The following will help you incorporate E-mail into your online activities.

Q What about E-mail? What do I need in order to send and receive E-mail messages?

A Well, besides the computer, modem, and telephone line, all you really need is an E-mail account and E-mail software. While most ISPs include an E-mail account, you do not have to have an ISP to have an E-mail account. Several companies, the most well known is Juno (http://www.juno.com), offer free E-mail accounts to users. Simply register online (if you don't have an Internet connection, use a friend's connection) and download the client software. Once you've configured the software, you'll be able to send and receive E-mail messages at no cost.

Of course, nothing is ever free. Users will see a healthy dose of advertising every time they log in to check their mail. In addition, the service isn't the best. Modems are sometimes down and often users have trouble getting through.

Web-based E-mail is also a popular option. Services such as Hotmail (http://www.hotmail.com) offer free Web-based E-mail accounts to users who have Web access. These accounts offer a lot of flexibility because users can view their account from any computer with Internet access. For example, if you don't have a computer at home but you want to receive E-mail messages at the local library, you may want to open one of these accounts. You may also want to open one of these Web-based accounts if you travel a lot.

Some people even use Web-based E-mail as a throwaway account, an address they give to commercial sites so they don't have to worry about their regular accounts filling up with junk E-mail (affectionately known as spam). Whatever your reason might be, the price is right, so why not sign up?

If you're using non-Web-based E-mail, such as an account from your ISP, then you have a wealth of software to choose from. You can download Microsoft Outlook Express for free at http://www.microsoft.com or as part of the Internet Explorer Web browser. You can also download the Netscape Communicator Suite, which features the Messenger E-mail client, at http://www.netscape.com. Qualcomm also offers the popular E-mail client, Eudora. You can download Eudora Lite free of charge at http://wwwqualcomm.com.

Q I get garbled E-mail messages from a friend all the time. How can I make sure recipients of my E-mail messages can read them?

A This is often caused either by the inability of your E-mail program to decode the information or incompatibility in software. E-mail clients such as Outlook Express default to send E-mail in HTML. While this allows most E-mail programs to read the messages, not every E-mail client can display messages in this format. If you want your E-mail to be easily viewable by a large amount of people, you should send E-mail as plain text. Check out the help menu in your E-mail program to find out more about this.

Q What is all the POP3, SMTP, and IMAP stuff I keep seeing?

A E-mail can be very confusing. Because most users don't have a permanent Internet connection, there must be a way for them to receive E-mail messages when they're offline. The answer is to store your E-mail on your service provider's computer. The messages stay on your service provider's computer until you retrieve them using your E-mail client. POP3 and IMAP are two different ways to retrieve messages from your service provider.

When you request your E-mail, **Post Office Protocol 3 (POP3)** downloads the messages from your ISP's computer to your personal computer and removes the message from the server after the transfer is complete. POP works with **Simple Mail Transfer Protocol (SMTP)**, which enables E-mail messages to be sent from one system to another. Interactive Mail Access Protocol (IMAP), on the other hand, maps the E-mail from your ISP's computer to your local computer. You can view it just as you would from your ISP's computer. When you delete an E-mail message locally, it remains on the server. If need be, you can go back and retrieve the information. Most ISPs use POP3 protocol for E-mail retrieval.

Q A friend sent me an attachment. What is it and how can I view it?

A Attachments are simply files (programs or documents) that someone has attached to an E-mail message and sent to you. The file can be anything from a small program to a Word or Excel document to a picture, animation, or sound. Most E-mail clients, including Outlook Express, Messenger, and Eudora Lite, will decode attachments. Once downloaded and decoded, these programs will save the file to a directory where you can open it at your discretion. To view some of the attachments, however,

What's In An Address?

To "go to" an Internet site or to request that a Web page be downloaded to your screen, you will need the proper Internet address, which must contain specific components to direct your request through the Internet addressing system.

http://www.smartcomputing.com

Hypertext Transfer Protocol: Protocol for the way computers exchange information on the Internet.

A World Wide Web page.

Domain name indicates the name of the system or location of the computer. The last three letters usually indicate the type of organization.

you will have to have the same program in which the attachment was created.

With some new viruses in circulation, you should be careful when opening and running attachments. While it is true that no virus can infect your computer through an E-mail message alone, it is entirely possible to infect your system by opening an infected E-mail attachment. It's always a good idea not to open attachments from people you don't know, and never open attachments, even from friends and family, if you don't have good antivirus software.

Q Can I get my kids their own E-mail accounts?

A Almost all ISPs offer multiple E-mail accounts. Some charge a nominal monthly fee for each additional E-mail account, while others offer extra accounts for free. You'll need to configure your E-mail client to take advantage of multiple inboxes by setting up additional POP3 and SMTP accounts as well as providing usernames and passwords.

Another option is to filter mail. You can set up a filter to scan the headers for friends of your son or daughter and automatically transfer them to a personal folder. This is certainly cheaper and may be the best idea. It also allows you to make sure the messages they are reading are appropriate.

Newsgroups & Usenet

Usenet is a bulletin board system maintained on the Internet. Here, users can post questions and comments in particular areas of interest and get feedback from other users. The following questions and answers should help newsgroup newbies get their bearings.

Q What is Usenet?

A Internet beginners tend to overlook one of the best sources for information and help on the Internet: Usenet. Usenet contains millions of newsgroups on the Internet covering every topic imaginable. You can find golf tips, fishing and hunting information, computer troubleshooting help, and even debates on the latest political and international affairs in Usenet and other newsgroups.

Internet beginners tend to overlook one of the best sources for information and help on the Internet: Usenet.

Usenet is a collection of hundreds of thousands of discussion forums on almost any topic. It uses a system of news servers to disseminate content around the globe. A client connects to a predefined news server and then can access all groups and messages posted on that server. Each news server links to several other news servers that, in turn, link to several other news servers. When you post a message to Usenet, the news servers distribute it to all the other news servers so everyone eventually has access to the post.

Q How do I access newsgroups?

A To access Usenet, you'll need a newsreader (Usenet client software) and an Internet connection. Microsoft's Outlook Express, in addition to being a capable E-mail client, is also a fine newsreader. Netscape's Messenger is also capable of handling Usenet. Another excellent newsreader is Forte's Free Agent. Your ISP also probably provides a news server. There are public servers you can use, but they're generally smaller and slower than the news servers provided by ISPs.

If your ISP sends you software that includes a newsreader, such as Outlook Express or Messenger, the program will more than likely be preconfigured to work with your ISP's news server. If you install a third-party newsreader, you will need to find out the domain name of your ISP's news server. If the news server is not public, you will have to enable authentication (the procedure by which a computer verifies user identification) and enter your Internet username and password.

Once you finish the configuration process, you'll need to get a listing of newsgroups offered by your ISP. Occasionally you may want to check for new groups; most news servers regularly add additional newsgroups to their list. Once the list has downloaded, you'll get to search through it for information that interests you. No one has the time to sort through them all, so try a keyword search for subjects that interest you.

Once you find a group that sounds interesting, subscribe to it. This will enable you to sift through only the newsgroups that you've deemed as being worthy of further investigation. For more information on newsgroups, consult your news server's help files.

Usenet, at its best, is a sort of university, a place to go to exchange information with your peers, learn more about the world around you, and help teach others. At its worst, it's nothing but noise, angry tirades, and objectionable posts. Although you'll often find useful information, there is no way to be certain that you can trust what others are telling you. Always take a post with a little skepticism. Usually if you see several follow up posts to a post, you can get a good feel for what's correct and what's not. A good way to avoid noise and spam (off-topic posts) is to subscribe to moderated discussion groups (usually denoted by "moderated" somewhere in the title). Moderate newsgroups can delete objectionable or off-topic posts and help keep the discussion on track. You can't find moderated groups for every subject and some people chafe at the idea of posting in a moderate forum, but these forums typically do offer more focused discussions.

Q What exactly is a thread?

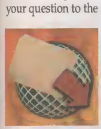
A A **thread** is a discussion of a certain subject. Usually, a person will post a question or comment on a given subject and others will reply. As the replies come rolling in, your newsreader can organize them so you can follow the discussion as it unfolds. Replies to a given post are proceeded by "Re:" in the subject line. If it's a hot topic, the original post may no longer reside on the server, in which case you'll have to try to infer as much as possible from the remaining threads. Generally several threads are running at any one time in a given group.

Q People often tell me I need to brush up on my Netiquette and read the FAQ. What are they talking about?

A Because newsgroups are a community, it's very important that you try to cooperate

with its standards so that discussions can proceed at an optimum rate. 'Netiquette is, as you might expect, online etiquette. It not only applies to newsgroup forums but also to much of the Internet. Small signature files, not writing in all caps, and only quoting the relevant parts of a post when replying are all things considered to be common courtesies towards others. 'Netiquette serves another purpose as well, to optimize the amount of room available for a discussion. Each news server only gives a specific amount of space to each newsgroup. Flame wars, repeatedly asked questions, long signature files, and complete postings of an entire thread take up space while contributing nothing to the overall discussion. That means more relevant information may be bumped from the server.

An FAQ is another means to the end of conserving bandwidth. Long-time group members often compile lists of questions. If a newsgroup has a FAQ (and most of the big ones do), read that before asking anything. There's no sense in taking up space with a question that's been asked 150 million times (besides, you probably won't get very helpful information from long-time group members). The majority of the time, you'll find the answers to your questions in the FAQ. If you still can't find an answer, search through the current posts before posing your question to the group.



File Transfer Protocol

File Transfer Protocol is still the primary method for transferring large files over the Internet. A number of free FTP sites house an impressive amount of freeware and shareware programs, but they're less user-friendly to navigate than a good Web site. Before you jump on one of these sites, read the following so you know what you are getting in to.

Q What is FTP?

A File **T**ransport **P**rotocol (FTP) is a standard way to transfer files between computers. FTP sites are depositories of software. FTP sites were immensely popular before the Web and still enjoy a sort of secret popularity. Users transfer many of the files downloaded from the Web (especially the larger files) from FTP sites.

An FTP site is nothing more than FTP server software running on a computer with its own IP address. Users always have to log on to an FTP site with a username and password. Many FTP sites, however, are set up to allow **anonymous FTP**. This is a service available at FTP sites (and other Web sites) that gives any user access to data files and FTP transmissions. With Anonymous FTP, users don't need a special password to retrieve the files. When you download a file using FTP over the Web, your browser automatically logs you in. Generally, an anonymous login will only give you access to public files. Some directories and files may be unavailable to you.

Q I'm trying to log on to an FTP site with my Web browser, but I keep getting an error message saying that the server returned extraneous data. Is there any way around this error?

A To safeguard performance and keep the server running at an optimal level, every FTP site is set up to allow a certain number of users to be on at any one time. If your browser returns some sort of error message, chances are the site has reached its maximum number of users. Sometimes, a Web page will provide you with a link to a mirror site. A mirror site is simply a replica of the original site on a different computer. These mirror sites give more people access to the main site's contents.

If you become a big fan of FTP, you'll probably want to pick up an FTP client such as WS_FTP (http://www.csra.net/junodj/ws_ftp32.htm)or CuteFTP (http://www.cuteftp.com). Either program will let you set up a list of favorite FTP sites and keep all your logon information for each site organized. Plus, the autoconnection feature is like an FTP redial. The software will continually try to establish a connection until it's finally successful. When the connection is successful, you can begin downloading.

Q Is it legal to download software from an FTP site?

A It depends on the software. Most well-known FTP sites allow users to download shareware or freeware applications. You can freely distribute shareware and use it for a certain evaluation period, but you'll have to pay a registration fee to continue using it at the end of the evaluation period. Freeware is as free as it sounds. Some users upload maps and modifications of popular computer games to be freely distribute via FTP. Recently, the Mpeg 3 (Mp3) revolution has spawned a large number of small FTP sites with large amounts of music titles available online. ■

by Chad Denton

9 Top Internet Sites

If you enjoy hanging out at all the popular places, then point your browsers to Yahoo! at http://www.yahoo.com. According to Media Metrix (http://www.mediametrix.com), more people visited Yahoo! than any other World Wide Web site during the month of May in 1999. Four of the top five sites in the survey are portal sites. These are Web sites that serve as windows to the Web. Their purpose is to guide surfers to just about anything they want to find online and provide as many services as possible in one place, such as free E-mail, stock listings, and personalized news. Geocities is a sort of portal, but it focuses much more on its internal sites.

1. Yahoo!
http://www.yahoo.com

2. AOL
http://www.aol.com

3. The Microsoft Network
http://www.msn.com

4. Geocities
http//www.geocities.com

5. The Go Network
http://www.go.com

6. Netscape
http://www.netscape.com

7. Microsoft
http://www.microsoft.com

8. Excite
http://www.excite.com

9. Lycos
http://www.lycos.com

Internet Statistics

We all know Internet usage has exploded in recent years. Several factors have contributed to this rise in the online population, such as falling PC prices, faster connection speeds, and more Internet service providers. But what about the issues behind all those users? In the following graphs, we take a look at why people are going online, examine some of the important issues they are facing, and explore the booming business of online commerce.

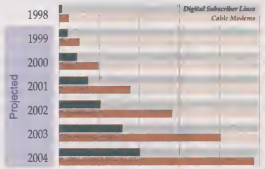
Top 15 Nations By Internet Population (1998)

Nation/Internet Users (in millions)

- United States 76.5
- Japan 9.75
- United Kingdom 8.10
- Germany 7.14
- Canada 6.49
- Australia 4.36
- France 2.79
- Sweden 2.58
- Italy 2.14
- Spain 1.98
- Netherlands 1.96
- Taiwan 1.65
- China 1.58
- Finland 1.57
- Norway 1.34

Source: Computer Industry Almanac

Digital Subscriber Lines & Cable Modems Installed In The United States (in millions)



Source: Computer Economics

Reasons To Go Online

	Female	Male
Education	16.7%	14.9%
Shopping/Researching Products	13	13.4
Entertainment	14.9	15.4
Work/Business	15.5	17.2
Communication (excluding E-mail)	9.6	8.7
Gathering Info For Personal Needs	20	18.1
Wasting Time	8.2	9.9
Other	2.1	2.2

Source: Georgia Tech Online Survey (October 1998)

Most Important Issue Facing The Internet

Source: Georgia Tech Online Survey (October 1998)

*Includes Content Accuracy, Crime, Equal Access, Commercialization, Intellectual Property, Junk sites, Paying

compiled by Marty Sems

Top E-Commerce Shopping Sites (measured in unique visitors/month)

1	Bluemountain.com	12,315,000
2	Amazon.com	9,134,000
3	Ebay.com	5,491,000
4	Barnes & Noble	4,692,000
5	Ebays.com	3,851,000
6	CNET Software Download Svcs.	3,450,000
7	Egghead.com	2,934,000
8	Cdnow.com	2,694,000
9	Musicblvd.com	2,686,000
10	Columbiahouse.com	2,452,000
11	Classified2000.com	2,259,000
12	Beyond.com	2,172,000
13	Coolsavings.com	1,889,000
14	Valupage.com	1,823,000
15	123greetings.com	1,753,000

Source: Media Metrix (December 1998)

Top Reasons To Shop Online

(respondents selected all that apply)

80%	Saves Time
78%	Is More Convenient
76%	Easier To Get Information
70%	Is More Hassle-Free
68%	Unsure Where To Find Certain Item
64%	Easier Shopping

Source: Greenfield Online (April 1999)

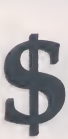
Top Reasons Not To Purchase Online

(respondents selected all that apply)

34.6%	Can't Judge Quality Online
28.8%	Security Concerns
25.8%	Question Not Applicable
22.6%	Privacy Concerns
17.4%	Easier To Get Locally
16.5%	Unfamiliar Vendor
13.7%	Not Enough Information
11.5%	Prefer To Deal With People
11.4%	No Receipt Or Documentation
10.4%	Other
8.0%	Uncomfortable With The Idea
7.5%	Never Tried It
7.1%	Hard To Find Appropriate Sites
6.7%	Site Has No Purchase Option
6.4%	No Credit Card
5.6%	No One Home To Receive Item
5.2%	Heard Advice Against It
5.0%	Too Complicated
3.5%	Against Purchasing Policy
2.4%	Had A Bad Experience

Source: Georgia Tech Online Survey (October 1998)

E-Commerce Revenues In The United States (in billions)



1998	$47
1999 (projected)	$116-$135
2000	$252-$367
2001	$422-$667
2002	$581-$968

Source: Giga Information Group

Web Site Information

You can find almost anything on the World Wide Web. Here are the addresses for a few popular sites in some different subject categories.

Agriculture

Ag Youth Magazine	http://www.agyouth.com
Equipment Locator Service	http://www.equipment-locator.com
Farm Journal Today	http://www.farmjournal.com
National FFA Online	http://ffa.agriculture.com
Successful Farming Agriculture Online	http://www.agriculture.com
USDA	http://www.usda.gov

Auctions

Auction Addict.com	http://auctionaddict.com
Bid4it!	http://www.bid4it.com
eBay	http://www.ebay.com
Haggle OnLine	http://www.haggle.com
ONSALE Auction Supersite	http://www.onsale.com
WebAuction	http://www.webauction.com

Automobiles

Auto By Tel	http://www.autobytel.com
Auto Connect	http://www.autoconnect.com
autoweb.com	http://www.autoweb.com
Car and Driver	http://www.caranddriver.com
CarPoint	http://www.carpoint.msn.com
Edmund's	http://www.edmunds.com
Kelley Blue Book	http://www.kbb.com

Business & Investing

Economy at a Glance	http://stats.bls.gov/eag.table.html
Microsoft Money Central	http://moneycentral.msn.com
NASDAQ	http://www.nasdaq.com
New York Stock Exchange	http://www.nyse.com
Quicken.com	http://www.quicken.com
Wall Street Journal Interactive Addition	http://www.wsj.com
Yahoo! Finance	http://quote.yahoo.com

Careers

CareerMosaic	http://www.careermosaic.com
CareerPath.com	http://www.careerpath.com
HeadHunter.NET	http://www.headhunter.net
HotJobs	http://www.hotjobs.com
Monster.com	http://www.monster.com

Computers & the Internet

Apple Computer	http://www.apple.com
Gateway	http://www.gw2k.com
IBM	http://www.ibm.com
Internet Sourcebook.Com	http://www.internetsourcebook.com
NetLingo	http://www.netlingo.com
PC Today	http://www.pctoday.com

Cooking & Food

Betty Crocker	http://www.bettycrocker.com
Food and Nutrition Information Center	http://www.nal.usda.gov/fnic
International Food Information Council	http://ificinfo.health.org
Pillsbury Central	http://www.pillsbury.com
Starchefs	http://www.starchefs.com
The Internet Food Channel	http://www.foodchannel.com

Culture & Society

Grolier Online's The American Presidency	http://www.grolier.com/presidents
Institute for the Study of Civic Values	http://www.libertynet.org/edcivic/iscvhome.html
National Association for Community Leadership	http://www.communityleadership.org
The Self-Help Guide to Successful Living	http://www.successful-living.com

Education

American Universities	http://www.das.ufl.edu/CLAS/american-universities.html
Ask ERIC	http://ericir.syr.edu
Campus Tours.com	http://www.campustours.com
FinAid: The Financial Aid Information Page	http://www.finaid.org
the Student Center	http://studentcenter.infomall.org
U.S. Department of Education	http://www.ed.gov

Games

Cybergames	http://www.cgnc.com
Gamelord.com	http://www.gamelord.com
Games Domain	http://www.gamesdomain.com
Gamespot	http://www.gamespot.com
Happy Puppy	http://www.happypuppy.com
PC Multimedia & Entertainment	http://www.pcme.com

Gardening

Come Into My Garden	http://www.hal-pc.org/~trobb/horticul.html
Dig the Net	http://www.digthenet.com
Garden.com	http://www.garden.com
Garden Web	http://www.gardenweb.com
The Garden Gate	http://www.prairienet.org/ag/garden
The Internet Garden	http://www.internetgarden.co.uk

Government

Central Intelligence Agency	http://www.odci.gov/cia
COPNet	http://police.sas.ab.ca/homepage.html
Federal Bureau of Investigation	http://www.fbi.gov
FedWorld Information Network	http://www.fedworld.gov
NASA	http://www.nasa.gov
The Library of Congress	http://lcweb.loc.gov
U.S. Environmental Protection Agency	http://www.epa.gov

Health

American Cancer Society	http://www.cancer.org
American Council on Exercise	http://www.acefitness.org
American Medical Association	http://www.ama-assn.org
American School Health Association	http://www.ashaweb.org
Centers for Disease Control and Prevention	http://www.cdc.gov
Doctor's Guide to the Internet	http://www.pslgroup.com/docguide.htm

Homes & Apartments

Ads 4 Homes	http://www.ads4homes.com
Apartments USA	http://www.aptusa.com
Cyberhomes	http://www.cyberhomes.com
HomeAdvisor	http://www.homeadvisor.msn.com
Home Classifieds	http://www.homeclassifieds.com
Rent.Net	http://www.rent.net
SpringStreet	http://www.springstreet.com/n.nd/ss/pgHome?

Kids

KidsCom	http://www.kidscom.com
Kids Domain	http://www.kidsdomain.com
Sesame Street Central	http://www.sesamestreet.com/sesame
Space Camp	http://www.spacecamp.com
Worldwide Wishbone	http://www.wwwishbone.com
Yahooligans!	http://www.yahooligans.com

Movies

All-Movie Guide	http://www.allmovie.com
Cinema FreeNet	http://www.link.cs.cmu.edu/cinfn
Hollywood Online	http://www.hollywood.com
Movies.com	http://www.movies.com
Screen it! Entertainment Reviews for Parents	http://www.screenit.com

Music (Classical)

Classical Music Online	http://www.scapecast.com/onworld/CMO
Classical Music on the 'Net	http://musdoc.com/classical
Classical Music on the Web	http://www.unc.edu/~baker/music.html
Classical Net	http://www.classical.net
ClassicWeb	http://classicweb.com
Classics World	http://www.bmgclassics.com/classics/index.html

Music (Country & Western)

Country.com	http://www.country.com
Country Now.com	http://www.countrynow.com
CountryCOOL.com	http://www.countrycool.com
CountrySong.com	http://soundmarket.net
Kickin' Country	http://kickincountry.com
The Academy of Country Music	http://www.acmcountry.com

Music (Pop & Rock)

CDNOW	http://www.cdnow.com
Jam TV Music Network	http://www.jamtv.com
Music Central	http://musiccentral.msn.com
Rolling Stone	http://www.rollingstone.com
The History of Rock & Roll	http://www.history-of-rock.com
The Rough Guide to Rock	http://www.roughguides.com/rock

Music (Jazz)

Absolute Jazz	http://abjazz.com
All about jazz.com	http://www.allaboutjazz.com
American Jazz Symposium	http://members.aol.com/AJSExec
Interjazz	http://interjazz.com
Jazz Online	http://www.jazzonln.com

News

ABC News	http://www.abcnews.go.com
CNN Interactive	http://www.cnn.com
FOX News	http://www.foxnews.com
MSNBC	http://www.msnbc.com
New York Times	http://www.nytimes.com
USA Today	http://www.usatoday.com
Washington Post.com	http://www.washingtonpost.com

Performing Arts

DanceArt.com	http://www.danceart.com
Musicals.net	http://musicals.net
Opera News Online	http://operanews.com
Playbill Online	http://www1.playbill.com
The Ballet Archive	http://www.kuwayama.com/balletarchive
The Operaphile	http://www.operaphile.com

Reference

Bartlett's Familiar Quotations	http://www.cc.columbia.edu/acis/bartleby/bartlett/
Funk & Wagnalls Knowledge Center	http://www.funkandwagnalls.com
Merriam-Webster Dictionary	http://www.m-w.com/dictionary.htm
Merriam-Webster Thesaurus	http://www.m-w.com/thesaurus.htm
Old Farmer's Almanac	http://www.almanac.com
Ultimate White Pages	http://www.theultimates.com/white

Software & Driver Downloads

GetRight.Com	http://www.getright.com
RighTime	http://www.rightime.com
Shareware.com	http://www.shareware.com
Winfiles.com	http://www.winfiles.com
WinZip	http://www.winzip.com
5-Star Shareware	http://www.5star-shareware.com

Sports

CNN/SI	http://www.cnnsi.com
ESPN Sportszone	http://espn.sportszone.com
Major League Baseball.com	http://www.majorleaguebaseball.com
NBA.com	http://www.nba.com
NFL.com	http://www.nfl.com
The Sporting News	http://www.sportingnews.com

Television

Cable TV Magazine	http://www.cabletvmag.com
Corporation for Public Broadcasting	http://www.cpb.org
The Infomercial Index	http://infomercialindex.com
TV Guide Online	http://www.tvguide.com
Ultimate TV	http://www.ultimatetv.com

Travel

AIRwise	http://www.airwise.com
Breezenet's Guide to Airport Rental Cars	http://www.bnm.com
Fodor's	http://www.fodors.com
Geographia	http://www.geographia.com
Parknet	http://www.nps.gov
Priceline.com	http://www.priceline.com

Visual Arts

Folk Art Society of America	http://www.folkart.orgVirtual Visit: The
International Sculpture Center Prints & Photographs	http://www.sculpture.org
Louvre	http://www.smartweb.fr/louvre
Reading Room:Lib of Cong.	http://lcweb.loc.gov/rr/print
Resource Library Magazine	http://www.tfaoi.com/resourc.htm
Public Art on the Internet	http://www.zpub.com/public

E-mail Information

Government & Politics

Bill Clinton, U.S. President	president@whitehouse.gov
Al Gore, U.S. Vice President	vice.president@whitehouse.gov
Hillary Clinton, First Lady	first.lady@whitehouse.gov
Tipper Gore, wife of Al Gore	mrs.gore@whitehouse.gov
Madeline Albright, U.S. Secretary of State	secretary@state.gov
Rep. J. Dennis Hastert (R-Ill.), U.S. Speaker of the House	dhastert@mail.house.gov
Sen. Trent Lott (R-Miss.), Senate Majority Leader	senatorlott@lott.senate.gov
Rep. Dick Gephardt (D-Mo.), House Minority Leader	gephardt@mail.house.gov
Sen. Tom Daschle (D-S.D.), Senate Democrat Leader	tom_daschle@daschle.senate.gov
Democratic Policy Committee, (U.S. Senate)	postmaster@dpc.senate.gov
Republican Policy Committee, (U.S. Senate)	mailbox@rpc.senate.gov
Sen. Ted Kennedy (D-Mass.)	senator@kennedy.senate.gov
Sen. John McCain (R-Ariz.)	John_McCain@McCain.senate.gov
Sen. Phil Gramm (R-Texas)	Phil_Gramm@gramm.senate.gov
Sen. Dianne Feinstein (D-Calif.)	senator@feinstein.senate.gov
U.S. Department of Justice	web@usdoj.gov
Environmental Protection Agency	public-access@epamail.epa.gov
United States Postal Service	consumer@email.usps.gov
U.S. Department of Education	CustomerService@ined.ed.gov
U.S. Bureau of Consular Affairs (passports and visas)	ca@hiu.com
Joint Chiefs of Staff	PublicAffairs@js.pentagon.mil
National Technical Information Service	redwards@ntis.fedworld.gov

Political Television Shows

"Face the Nation with Bob Schieffer"	ftn@cbsnews.com
"Fox News Sunday"	Sunday@foxnews.com
"Meet the Press"	MTP@MSNBC.com
"The McLaughlin Group"	oliverprod@aol.com
"Washington Week in Review"	wwir@weta.com

Media

ABC News	http://www.abcnews.go.com/onair/email.html
CBS Network	marketing@cbs.com
Fox News	comments@foxnews.com
Fox Network	askfox@foxinc.com
NBC Nightly News	nightly@nbc.com
CNN Networks	on-air@turner.com
PBS	viewer@pbs.org
Comedy Central	mail@comedycentral.com
MTV	mtvamp@aol.com (online)
Sci-Fi Channel	scifiwire@scifi.com
VH1	Request@vh1.com
National Public Radio (NPR online)	nprnews@npr.org
Newsweek	Editors@newsweek.com
Car and Driver	editors@caranddriver.com
Forbes	readers@forbes.com
Fortune	fortune-letters@pathfinder.com
Fox Kids (go to FAQs, Thoughts & Comments)	http://www.foxkids.com
Life	lifeedit@life.timeinc.com
Harper's	http://www.harper's.com
National Geographic	ngsforum@nationalgeographic.com
Parents	mailbox@parentsmagazine.com
Popular Mechanics	pmwebmaster@hearst.com
Rolling Stone	rollingstn@palmcoastd.com
Sports Illustrated (Letters to the Editor)	letters@si.timeinc.com
Time (Letters to the Editor)	letters@time.com
U.S. News & World Report	tlunger@usnews.com
Village Voice	editor@villagevoice.com
Boston Globe	ask@globe.com
Chicago Tribune	http://www.chicagotribune.com/interact/email
Chicago Sun Times	letters@suntimes.com
Christian Science Monitor	support@csmonitor.com
Denver Post	letters@denverpost.com
Detroit Free Press (online)	webmizr@freepress.com
Houston Chronicle	hci@chron.com
Los Angeles Times	letters@latimes.com
New York Times	feedback@nytimes.com
San Francisco Chronicle	chronfeedback@sfgate.com
Vanity Fair	vfmail@vf.com
Washington Post	webnews@washpost.com
Wall Street Journal	inquires@interactive.wsj.com

Entertainment

Television Programs

"Today"	Today@MSNBC.com
"Dateline NBC"	dateline@nbc.com
CBS programs	http://www.cbs.com/flat/frameset_feedback3Fp5Fwho3Dnetwork.html
"News Hour with Jim Lehrer"	newshour@pbs.org
"Politically Incorrect"	http://abc.go.com/pi/talkback/talk_index.html
"Antiques Road Show"	http://www.pbs.org/wgbh/pages/roadshow/mailbag.html
"The Tonight Show with Jay Leno"	Tonightshow@nbc.com
"Late Night With Conman O'Brien"	Latenight@nbc.com
"Late Show with David Letterman"	lswd@aol.com
"The Late Late Show"	latelateshow@cbs.com
"The Drew Carey Show"	DrewCShow@aol.com
"The X-Files"	http://www.thex-files.com/feedback.htm
"Friends"	friends@nbc.com
"Just Shoot Me"	justshootme@nbc.com
"Days of Our Lives"	days@nbc.com
"The Young and The Restless"	yrbb@cbs.com
"Frontline"	frontline@pbs.org
"Motor Week"	motorweek@mpt.org
"NOVA"	nova@wgbh.org
"The Red Green Show"	red@redgreen.com
"Understanding and Using the Internet"	loquestions@pbs.org
"This Week in Business"	http://cgi.pbs.org/weta/twib/contact
"Wall Street Week"	transcripts@mpt.org
"Bill Nye the Science Guy"	billnye@mylealbs.com
Children's Television Workshop (Sesame Street)	ctw-comments@ctw.org
"Space Ghost: Coast to Coast"	SGC2C@aol.com
"The Magic School Bus"	msbfun@scholastic.com
"Where in the World is Carmen Sandiego"	feedback@wgbh.org
'Scientific American Frontiers'	http://www.pbs.org/saf/1_season/17_contact.html

Television Personalities

Bill Moyers	http://www.pbs.org/voice/faq.htm#moyers
Derek McGinty	http://www.pbs.org/weta/straighttalk
Oprah Winfrey	harpo@interaccess.com
Martha Stewart	mstewart@msl.timeinc.com

Movie Personalities

Rodney Dangerfield	rodney@rodney.com
Clint Eastwood	rowdiyates@aol.com
Roger Ebert	73136.3232@compuserve.com
Steve Martin	TheGILB@aol.com
Brad Pitt	CLAOBOY@msn.com
Wesley Snipes	herukush@aol.com
James Woods	jamesoods@aol.com

Music

Atlantic Records	web@atlantic-records.com
Rhythm & Blues Music	staff@galaxy.com
Capitol Records	mail@hollywoodandvine.com
Columbia Records	feedback@columbiarecords.com
Virgin Records	virgin@media.virginrecords.com
"Austin City Limits"	info@www.klru.org
Chopin Foundation of the United States, Inc.	info@chopin.org
Cybergrass (online)	Cybergrass@banjo.com
Cajun/Zydeco Music & Dance	http://www.bme.jhu.edu/~jrice/cz.html
Jazz Emporium Cafe	kowerwrath@aol.com
Jazz Online	jazzonline@azzonline.com
Living Music Foundation	lmfnone@e.e-universe.com
"Mountain Stage Radio Program"	stage@wvlc.wvnet.edu
The Rock and Roll Hall of Fame	visit@rockhall.com
Tower Records	feedback@towerrecords.com

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http://www.senate.gov/senator/membemail.html
http://consumer.baweb.com/cgi-local-bin/htmsrch.cgi
http://netmag.simplenet.com/auto/index.html
http://www3.sdsndnet.com/~/furee/faxmail.html
Other E-mail addresses gathered from various individual sites on the World Wide Web.

10Base-2—An Ethernet local-area network (LAN) that uses thin coaxial cable rather than full-specification cable to connect the circuits required for a network. The term stands for its baseband transmission at 10 megabits per second on a cable with a maximum length of 200 meters. Also known as cheapernet or thinnet because of the thin coaxial cable. See baseband transmission. See **Ethernet**. See **local-area network**.

10Base-T—A version of Ethernet, a local-area network (LAN), which allows workstations to be connected by a twisted, thin, coaxial cable at up to 100 meters. The term stands for its baseband transmission at 10 megabits per second on a twisted-pair cable. See **10Base-2**. See **Ethernet**. See **local-area network**.

100Base-T—An Ethernet local-area network (LAN) that transmits data at speeds up to 100 megabits per second (Mbps), as opposed to the standard Ethernet speeds of 10Mbps. It transmits data over twisted-pair cables. This is a technical name for fast Ethernet. See **Ethernet**. See **local-area network**.

101-key keyboard—The now-standard computer keyboard that has 101 keys, including specialized keys such as function keys, arrow keys, and a number pad. Also called the AT keyboard because most are variations on the keyboard introduced by IBM with its PC/AT computers.

1.2MB—The maximum capacity of a high-density, 5.25-inch diskette in megabytes. See high-density diskette.

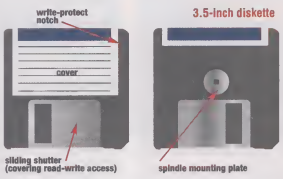
14.4Kbps modem—A modem that transfers data at speeds up to 14.4 kilobits per second. See **kilobits per second**. See **modem**.

1.44M—Stands for 1.44 megabytes (MB), the maximum amount of data a high-density, 3.5-inch diskette can hold. These diskettes are currently the most popular. See **3.5-inch diskette**.

16-bit—Computers or applications that work with data in groups of 16 bits at a time. A computer that is described as 16-bit might have a microprocessor capable of handling 16 bits of information at a time. More commonly, 16-bit also can describe the width of the computer's bus. A 16-bit bus is able to transport 16 bits of data at a time, linking the internal sections of a computer (CPU, expansion cards, peripherals, etc.). Intel Corp.'s 80286 microprocessor is 16-bit.

286—See 80286.

28.8Kbps modem—A modem that transfers data at speeds of no more than 28.8 kilobits per second. See **kilobits per second**. See **modem**.



3.5-inch diskette—A transportable device, popularized in the late 1980s, on which computer data are stored. These diskettes are thin, square-shaped objects with geometrical dimensions of 3.5 x 3.5 x 0.125 inches. The 3.5-inch diskettes, which also are known as floppy diskettes, consist of a rigid plastic shell that contains a floppy circular Mylar disk that magnetically records data. Traditionally, 3.5-inch diskettes come in two formats: the 720KB low-density (also known as double-density) diskette and the 1.44MB high-density diskette. The 1.44MB diskette presently is the most popular. A 2.88MB diskette has been released but has failed to gain widespread usage. See **diskette**.

32-bit—Computers or applications that work with data 32 bits at a time. A 32-bit computer might have a microprocessor capable of handling 32 bits of information at a time. More commonly, 32-bit also can describe the capability of the computer's bus to transport 32 bits of data at a time. Most computers based upon Intel Corp.'s 80386 microprocessor are 32-bit machines. A 32-bit operating system such as OS/2 Warp, Windows 95, or Windows NT works with information in 32-bit groups.

360K—The maximum capacity, in kilobytes, of a single-density, 5.25-inch diskette. See **single-density diskette**.

386—See 80386.

3-D—See **three-dimensional**.

3-D audio—See **three-dimensional (3-D) audio**.

3-D video—See **three-dimensional (3-D) video**.

486—See 80486.

5.25-inch diskette—A transportable device, popularized in the late 1970s, on which computer data are stored. These diskettes are thin, square-shaped objects with geometrical dimensions of 5.25 x 5.25 x 0.0625 inches. The 5.25-inch diskettes, which also are known as floppy diskettes, consist of a flexible plastic jacket that contains a floppy circular Mylar disk that magnetically records data. Traditionally, 5.25-inch diskettes come in two formats: the low-density (also known as double-density) 360KB diskette and the high-density 1.2MB diskette. Although at one time the 5.25-inch diskette could be found on almost every computer, by late 1994 the 3.5-inch diskette overwhelmingly had become the most popular form of portable data storage. See **diskette**.

56K line—A data transmission line with the capacity to move information at 56,000bps.

56.6Kbps modem—A modem that transfers data at speeds up to 56.6 kilobits per second, which currently is the fastest modem speed. See **modem**. See **kilobits per second**. See **V.90**.

586—The unofficial name given to the Pentium processor, the CPU released by Intel Corp. in 1993 to replace the 486 processor. Intel Corp. called its new processor the Pentium because it was a marketable name and easily protected by copyright laws. Many people in the computing industry, however, referred to the Pentium processor as the 586 in reference to its predecessors, which were called the 286, the 386, and the 486. See **686**. See **Pentium**.

64-bit—Computers or applications that work with data 64 bits at a time. A 64-bit computer might have a microprocessor capable of handling 64 bits of information at a time. More commonly, 64-bit also can describe the capability of the computer's bus to transport 64 bits of data at a time.

686—The name given to Pentium Pro-class processors produced by Intel Corp. competitors. The name refers to the successful line of Intel processors, known as the 286, the 386, and the 486, that preceded the Pentium. The processor that would have been called the 586 was named the Pentium. See **586**. See **Pentium**.

720K—The maximum capacity, in kilobytes, on a double-density, 5.25-inch or 3.5-inch diskette. See **double-density diskette**.

80286—A microprocessor made by Intel Corp. beginning in 1982, commonly called the 286. The 286 featured a 16-bit architecture, supported virtual memory, and was available in clock speeds of 8MHz, 10MHz, and 12MHz. The 286 was five to 20 times faster than its predecessor, the 8088.

80287—A floating-point math co-processor designed to complement Intel Corp.'s 80286 microprocessor. Many 286-based computers have a special socket designed to accept the optional 287. A math coprocessor can significantly boost the speed of certain calculation-intensive applications. See **floating-point coprocessor**.

80386DX—A microprocessor made by Intel Corp. beginning in 1989, commonly called the 386DX. The 386DX featured 32-bit architecture, included built-in multitasking, and was available in clock speeds of 16MHz, 20MHz, 25MHz, and 33MHz. The 386DX was compatible with all 286 software and more than twice as fast as the 286. Like all Intel chips, it was compatible with earlier versions of the 80x86 line.

80386SL—A version of Intel Corp.'s 386DX microprocessor first manufactured in 1990. It featured low power consumption and was used mainly in portable computers.

80386SX—A microprocessor made by Intel Corp. beginning in 1988. The 386SX was a cheaper version of the 386DX; it lacked a math coprocessor that is useful for certain large mathematical applications. Like the 386DX, the SX featured a 32-bit architecture and built-in multitasking. It also was available in clock speeds of 16MHz, 20MHz, 25MHz, and 33MHz.

80387—A floating-point math co-processor designed to complement Intel Corp.'s 80386 microprocessor. Most 386-based computers have a socket designed to accept the optional 387. A math coprocessor can significantly boost the speed of certain calculation-intensive application. See **floating-point coprocessor**.

80387SX—A floating-point math coprocessor designed to complement Intel Corp.'s 80386SX microprocessor. Many 386SX-based computers have a special socket designed to accept the optional 387SX. A math coprocessor can significantly boost the speed of certain calculation-intensive applications. See **floating-point coprocessor**.

80486DX—An Intel Corp. microprocessor debuted in 1989. Commonly called the 486 or 486DX, the chip featured a built-in memory cache and 32-bit architecture. It had more than three times the 386DX's computing power and was available in clock speeds of 25MHz, 33MHz, and 50MHz. Like all Intel chips, it was compatible with earlier versions of the 80x86 line, including the 80286 and 80386. Also known as the i486.

80486DX2—An Intel Corp. microprocessor first manufactured in 1992. It was based upon the popular 486DX but featured internal clock speeds double that of the system that operated it. Thus, a DX2 on a system with a 33MHz bus would run at 66MHz. Also known as the i486DX2.

80486DX4—An Intel Corp. microprocessor first manufactured in 1994. It was based upon the 486DX but featured internal clock speeds triple that of the system that operated it. Thus, a DX4 on a system with a 25MHz bus would run at 75MHz. Also known as the i486DX4.

80486DX4

80486SL—A version of Intel Corp.'s 486DX microprocessor first manufactured in 1990. It featured low power consumption and was used mainly in portable computers.

80486SX—A less expensive version of the 80486DX made by Intel Corp. beginning in 1991. The 486SX lacked the math coprocessor of its full-featured sibling. It also ran at slower clock speeds than the DX—16MHz, 20MHz, 25MHz, or 33MHz. Also known as the i486SX.

8080—An Intel Corp. microprocessor first manufactured in 1974. The 8080 had an eight-bit architecture.

8086—An Intel Corp. microprocessor first manufactured in 1978. The 8086 had a 16-bit architecture that allowed it to work with 16-digit binary numbers and pass them through a 16-bit data bus to other support chips. The 8086 was available in clock speeds of 5MHz,

8MHz, and 10MHz. Although it preceded the 8088 microprocessor, the 8088 chip was selected for the IBM PC because supporting chips with 16-bit buses were more expensive than their eight-bit bus counterparts. Aside from this difference, the 8086 could be programmed the same way as the 8088 microprocessor. Later, when 16-bit bus chips were less expensive, the 8086 microprocessor appeared in PC clones.

8087—A floating-point math coprocessor designed to complement Intel Corp.'s 8086/8080 microprocessor family. A math coprocessor can significantly boost the speed of certain calculation-intensive applications. See floating-point coprocessor.

8088—An Intel Corp. microprocessor first manufactured in 1979. The 8088 was used in the original IBM PC and XT personal computers because it was less expensive than the 8086 microprocessor. The availability of less expensive eight-bit data bus supporting chips made it the microprocessor for the IBM PC. It was available in clock speeds of 4.77MHz and 8MHz. The 8088 featured an eight-bit data bus for moving data into and out of the PC. Its 16-bit architecture did allow it to work internally with 16-digit binary numbers. The 8088 had the ability to address up to 1MB of RAM.

8514/A—An IBM graphics display standard with a 1024 x 768 resolution.

8-bit—Computers that work with data eight bits at a time. More commonly, eight-bit can also describe the capability of the computer's bus to transport data eight bits at a time. Computers based on Intel Corp.'s 8088 microprocessor transport data eight bits at a time.

A

A—See ampere. See angstrom.

A:—When followed by a colon, A refers to the A: drive, the first diskette or hard drive on a network or inside a computer. On many PCs, the A: drive is a 5.25-inch or a 3.5-inch diskette drive, but the drive letter can be changed by the user.

AAC—See Advanced Audio Coding.

AAF—See Advanced Authoring Format.

A-B box—A control mechanism that lets two or more computers share a single peripheral, such as a printer, a scanner, or a monitor. With an A-B box in use, the user can decide which computer is able to use the device at any one time by turning a switch.

ABIOS—See Advanced BIOS.

abort—To intentionally and prematurely terminate an active computer command.

abort, ignore, retry, fail—A DOS error message that appears when a non-functioning drive has been accessed. Some form of this message most often appears when a user attempts to access an empty diskette drive.

about—In Windows-based applications, an option that, when activated, identifies the registered user of the program, the version number, and the program's creator. The About command usually is located in the Help menu.

A-B box

absolute address—See direct address.

absolute cell reference—In spreadsheets, a reference to a specific cell based on a cell's exact location in the sheet. Most spreadsheets have the capability to automatically fill cells with formulas that change based on where the cell is located. For instance, a formula that commands the computer to add the data in cell A1 to the data in cell F4 uses absolute cell references. A formula that adds data in the first cell to the right with the data in the first cell to the left, regardless of the exact location, uses a relative cell reference. See relative cell reference.

absolute coding—A system of programming that uses direct addressing rather than indirect addressing to specify the location of data in the memory. Direct addressing refers to the exact location of data in a computer's memory, whereas indirect addressing determines the location of data in a computer's memory by relating its position to another point. See direct address. See indirect address.

absolute coordinates—Points on a plane or grid that are defined by their distance from a point known as the origin. See origin.

absolute pointing device—A peripheral that is limited by the boundaries of an on-screen application window as it manipulates the movement of a cursor.

absolute value—The value of a number as determined by its distance from zero on a number line without regard to whether the number is positive or negative. For example, the absolute value of both 3.5 and -3.5 is 3.5.

abstract data type—In programming, an information type defined by the kind of data it can contain rather than the data it actually does contain. For example, "date" is an abstract data type while Thursday, September 3, 1998 is actual data.

A-B switch box—See A-B box.

AC—See alternating current.

Accelerated Graphics Port (AGP)—A high-speed graphics port that allows fast

access arm

communication between the graphics controller and computer. This port runs at least twice as fast as older Peripheral Component Interconnect (PCI) video cards and allows the graphic card to directly access the computer's main memory. AGP allows 3-D textures for texture mapping to be stored in main memory, while PCI graphics cards allow textures to be stored only in the smaller video memory. The AGP port also bypasses the PCI bus, through which traffic can be heavy, since it also is used by network cards, some modems, SCSI adapters, and other add-in cards. Thus, with AGP, performance is improved for both the graphics card and PCI bus. AGP requires a motherboard that supports Pentium II or certain AMD or Cyrix chips and contains an AGP slot. Windows 95 OSR 2.1 or Windows 98 also is required. To see if you have the required version of Windows 95, click Control Panel, System, and select the General tab. If you have the "Microsoft Windows 95 4.00.950 B" or "4.00.950.1111." See **Peripheral Component Interconnect**, **texture mapping**.

accelerator—Any device that quickens the processing speed of a hardware component, usually by taking over some tasks originally assigned to the component. A video accelerator card is one example. It lessens the load on a computer's CPU by performing graphics work.

accelerator board—A printed circuit board that speeds up the microprocessor's performance, either by bolstering the power of the CPU or supplanting the microprocessor altogether.

accelerator card—See accelerator board.

accelerator key—See shortcut key.

access—To obtain an open channel of communication with a software application or computer component so the user can work with it. For instance, a computer must access an attached modem before it can be used.

access arm—In a hard drive, the arm-like mechanism that positions the read/write head over a disk surface. The read/write head is attached to the end of the access arm.

access code—An identifying string of characters used to regulate admittance to an application, data file, online service, local-area network (LAN), etc. An access code distinguishes users who have legal access from those who do not. A password is an access code comprised of letters. See **password**.

access control—The ability to allocate computing resources based on a user's identity. A simple example is the setting of a password on your computer that keeps it from working until the password is entered. Administrators also can use special software on a network to customize access according to user identity. Such software usually allows levels of access to be set.

access mechanism—A device or software driver that allows one component or application to communicate with another. For example, an access arm positions a read/write head for communication with a hard disk; a device driver allows a software application to communicate with the computer system.

access method—See protocol.

access number—The telephone number dialed by a modem that allows a computer to communicate with an online service or the Internet.

accessory—See auxiliary device.

accessory slot—See expansion slot.

access path—The complete route, including the drive letter, directory, and all subdirectories, that directs an operating system to a file or application in a storage device. For example, the access path C:\WINDOWS\ SYSTEM\Awadpr32 indicates the Awadpr-32 file is stored in the SYSTEM subdirectory in the WINDOWS directory, which is on the C: drive. Also called directory path.

access provider—See Internet service provider.

access rights—The rights a user or computer has to open up a communications pathway with a particular computer, component, or application. Limiting access rights keeps specific people, machines, or groups from using a certain network, machine, or files. Access rights usually are controlled through the use of passwords and codes.

access server—On a network, a computer designed to allow computers that are not part of a network to connect to and communicate with the network. The primary function of an access server is to provide a point of access for these unconnected computers. This function differs from that of a file server although a single computer could serve as both. Although an access server allows other computers to access a network, a file server is the computer upon which network files are stored. The file server is accessible through the access server.

access time—The length of time that is required for a computer system to process a data request and then retrieve the data from memory, a storage device, or the Internet. This access time can range from a few nanoseconds when accessing a file in the computer's memory, to hours when retrieving a large amount of data from the Internet.

A

account—In communications, a registered or billed connection with a network, an online service, or an Internet service provider (ISP). Online accounts are used to keep track of connect time and monthly service costs. In multiuser networks and operating systems, accounts primarily are used for identification purposes.

accounting machine—A non-electronic computer system used in the 1940s and 1950s that organized and calculated financial data for large companies. Although relatively primitive by modern standards, these early machines were great improvements over ledger accounting methods. An accounting machine is any device used only for accounting purposes. An accounting machine in the 1990s usually refers to any electronic computer reserved specifically for the operation of accounting applications.

account policy—In multiuser networks and operating systems, the set of rules that maintains order on the network and determines user access privileges. The account policy can dictate whether an individual is granted system access and whether an approved user can be given more access. It also typically lists standards users must abide by to continue using the system.

ACK—See acknowledgment.

acknowledgment (ACK)—A signal sent between computers on a network or between components in a single computer system indicating either a data transmission has been received or the computer or component is ready to receive a transmission. In ASCII, the acknowledgment signal is part of the first 32 values, which are reserved for communicating and printing information.

ACM—See Association for Computing Machinery.

acoustic coupler—An early computer communications device that enabled a computer to connect to the Internet. This early modem, which transmitted data at a rate of 300 baud (about 300bps) created a connection between a computer and the Internet using sound rather than electronic signals. The connection between the computer and the telephone line was created when a user manually positioned the telephone handpiece into the molded cradle of the acoustic coupler, which was connected to the computer. The acoustic coupler converted the electronic signal of the computer into an audio signal that was transmitted over a telephone line, and vice versa. Most modems today are direct-connect modems that require a phone line to be plugged into the modem, while another line connects the modem to the telephone.

ACPI—See Advanced Configuration And Power Interface.

action statement—Any distinct and executable command that initiates an action for the computer. The command might consist of a single word or a series of words and might perform one action or a number of related actions. An example is the clear command, which in many computer languages clears the screen. An action statement differs from an expression, which designates a value instead of performing an action.

active—Describes an application or file that currently is operational.

active cell—In a spreadsheet, the cell (the point at which a row and column intersect) currently open for data manipulation. The active cell, which can hold text, a numerical value, or a formula, ordinarily is highlighted.

Active Desktop—Using push technology, Microsoft's addition to its World Wide Web browser, Internet Explorer 4.0 and higher, turns the entire Desktop into a Web page-like interface, complete with active hyperlinks to system, network, and Internet resources. This means that Active Desktop becomes part of your operating system. See push.

active file—Any data file that currently is open and able to receive or transmit data.

active heat sink—A heat sink with a fan attached. A heat sink transfers heat away from a computer's main processor. A regular heat sink often is a ridged block of metal glued to the top of the chip that conducts the heat up and away from the chip. Active heat sinks replace most of that metal with a fan that serves the same purpose: to move heat away from the processor. Since active heat sinks have a moving part (the fan), they can fail, unlike a block of aluminum. Failure could lead to the processor being damaged because of overheating. The heat sinks that are best at conducting heat away from the processor have low thermal resistance, which is expressed in degrees Celsius per watt. The amount of air the fan can move also is important, and it is expressed as the rate of cubic feet per minute.

active-matrix display—A flat-panel display used in many notebook computers in which every pixel (tiny picture element) is controlled and adjusted by its own transistor, which creates a sharp image. Active-matrix screens are more expensive to produce than other major types of displays for portable PCs. Compare to **passive-matrix display**.

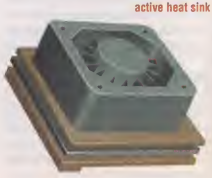
active-matrix, liquid-crystal display (AMLCD)—A liquid-crystal display (LCD) technology that presents and maintains better image quality than passive-matrix LCD technology in computer monitors. See liquid-crystal display. See **passive-matrix display**.

active-matrix screen—See active-matrix display.

active partition—In a partitioned hard drive (one that has been broken up into smaller units), the active partition is the one that contains the operating system currently in use. Only one partition can be active at a time. See **partition**.

active program—Any application that currently is open and able to process data.

active heat sink

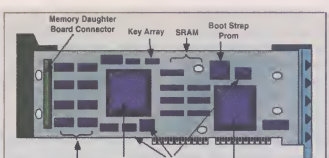


Active Server Page (ASP)—A specification for World Wide Web pages whose content is produced by a Virtual Basic or JScript program running on a remote server. The difference between an ASP and a regular Web page is that regular Web pages are static unless manually updated. An ASP, however, can change each time it's viewed, without someone manually rewriting the content. The page changes because the program that's running on the remote computer can produce different results when a page is called. One example would be a Web site that allows you to search for airline ticket prices online. You have to enter your origin, destination, and the time and date you want to fly. With Active Server Pages, the data you enter would be put into a program on a remote computer. That program would take the information you've given it and return a list of airfares in an ASP.

Active Streaming Format (ASF)—A file format used for creation and playback of streaming audio and video. The format is being developed by Microsoft and is used in that company's NetShow player.

active window—In a graphical user interface (GUI), the display box currently affected by on-screen cursor movement. The active window usually is a different color than other windows or is at the forefront of the screen. Active windows usually contain what the user currently is working on.

ActiveX—A program introduced by Microsoft Corp. that is used to instruct certain technologies how to involve component object model (COM) and object linking and embedding (OLE) functions. ActiveX can be incorporated within most programming languages. It lets Web site creators make interactive, multimedia Web pages and links to Microsoft Desktop products to the World Wide Web. For instance, through ActiveX controls, users could view Microsoft Word or Microsoft Excel documents through Microsoft Internet Explorer. Although the results of ActiveX controls may be similar to those of Java applets, Java is a programming language, while ActiveX is a set of controls written with Microsoft's Visual Basic. See **ActiveX control**. See **component object model**. See **object linking and embedding**.



adapter card

ActiveX control—Rules, written in a variety of computing languages, that let programs share data. Controls often are used to display special content, such as multimedia, in the Microsoft Internet Explorer browser. ActiveX controls provide functions similar to Java applets but rely on the Windows operating systems, whereas applets are meant to be cross-platform for operating systems. An example of an ActiveX control is Dimension X's Liquid Motion, which allows for the creation and viewing of compressed multimedia files. See **applet**. See **cross-platform**.

activity ratio—The ratio of active records to the total number of records in a file, useful in determining the load on a database.

ACTOR—An object-oriented programming language for Microsoft Windows with a Pascal/C-like syntax. See **C**. See **object oriented**. See **Pascal**.

actuator—The tiny motor that moves the access arm (and the attached read/write heads) above the surface of the disks in a hard drive. Two types of actuators are commonly used today: a stepper motor, which moves the access arm above the disk in a series of discrete steps, and a newer voice coil, which creates a fluid movement by the access arm and is more efficient. See **stepper motor**. See **voice coil**.

Ada—A high-level programming language developed in the late 1970s and early 1980s for proprietary use by the U.S. Department of Defense. Ada can handle almost any task, from simple accounting applications to complex missile guidance systems, and it has been a popular programming language within the Department of Defense since its creation. Ada was named after the early computer pioneer Augusta Ada Byron, Countess of Lovelace (1815-1852). She was instrumental in helping Charles Babbage conceptualize the analytical engine, a device that would have performed mathematical and logical operations and stored information.

adapter—See adapter card.

adapter card—A printed circuit board connected to the motherboard at an expansion slot. An adapter card enables a computer to communicate with a peripheral. For example, a joystick requires an adapter card to communicate with the computer system. Also called controller card.

adaptive differential pulse-code modulation (ADPCM)—A family of sound compression algorithms that digitizes analog audio signals. The algorithms use advanced pulse-code modulation (PCM) techniques that offer four times the compression of regular PCM. The compression is achieved by coding the difference between sound samples and dynamically switching the coding scale to compensate for variations in amplitude and frequency. PCM, on the other hand, codes an absolute measurement at each sample point, which requires more samples and more disk space.

adaptive system—A computer system that automatically conforms or adjusts to experience and environmental stimulation. See **artificial intelligence**. See **expert system**.

ADC—See analog-to-digital converter.

A-D converter—See analog-to-digital converter.

A

adder—A logic circuit in a computer's arithmetic logic unit (ALU) that adds binary numbers. There are two types of adders: half-adders and full-adders. Half-adders add one-digit binary numbers; a full-adder adds larger binary numbers, but it also works with a half-adder and can perform more complex operations, including carrying over numbers. For larger numbers, more than one full-adder is used—one for each digit in the binary numbers added. See **arithmetic logic unit**.

add-in board—A printed circuit board that expands the capabilities of the entire system, such as a sound card or modem. Add-in boards connect to a computer at an expansion slot. See **expansion slot**.

add-in card—See **add-in board**.

additive primary colors—See **red-green-blue (RGB)**.

add-on—Any component installed in or connected to a computer that expands the capabilities of the entire system. Modems and printers are two examples.

add-on board—See **add-in board**.

address—In data storage, the location of data in a storage device, defined as either a direct address or an indirect address. In communications, the location of a network computer or account. An example would be the unique Internet Protocol (IP) address by which each computer on the Internet is known to the rest of the system. See **direct address**. See **indirect address**.

addressable cursor—A cursor that may be directed immediately to any location on the computer screen. Normally this is accomplished using a multiple key combination. For example, using the CTRL-HOME key combination will position the cursor at the top of most word processing documents.

address book—A feature of most E-mail programs that lets users maintain and store multiple E-mail addresses. The address book enables users to easily send an E-mail message to multiple recipients. It allows users to click the addresses they want and then let their E-mail program automatically add each selected address to the header or the To: field.

address bus—An electronic pathway through which the CPU specifies memory locations for the storage of data. The size of the address bus determines how many different memory locations the CPU is able to address, or use. Today's PCs have 32-bit data buses, which means the pathway consists of 32 lines. The various combinations in which these 32 lines can be turned on or off means the CPU can address up to 4GB of memory.

address decoder—See **memory management unit**.

address mark—See **index mark**.

address register—A portion of a computer's memory reserved for keeping track of the location of data in memory.

addressable cursor

Address Resolution Protocol (ARP)—A Transmission Control Protocol/Internet Protocol (TCP/IP) that helps a host network process Internet protocol (IP) addresses and use them to find the actual, physical hardware locations that correlate to the virtual IP addresses. Compare to **reverse address resolution protocol**.

ADP—See **automatic data processing**.

ADPCM—See **adaptive differential pulse-code modulation**.

ADSL—See **Asymmetric Digital Subscriber Line**.

Advanced Audio Coding (AAC)—A new competitor to the MP3 standard, AAC lets users download CD-quality recordings to their computers. The new standard promises better compression and, thus, faster download times than the now widely used MP3 standard. AAC's developers claim the compression reduces the download time of a 3-minute song from 21 minutes to 9. There are several variations of AAC, however, and they aren't interchangeable. The two major AAC players, Liquid Audio and a2b, are incompatible. The Liquid Audio player can't play a2b-encoded AAC files, and vice versa. There are also some players and encoders based on the public domain version of the AAC format available for free, but that software is still in its infancy, so it's slow and buggy. See **MPEG-1-Layer III (MP3)**.

Advanced Authoring Format (AAF)—An effort by Microsoft Corp. to develop a content type that would allow users to design multimedia files in one program and edit them in another. AAF is geared more toward those who produce multimedia (sounds, pictures, graphics, animation, and movies) than end-users. The format's advantages are that it is cross-platform (unlike current multimedia content types, such as .AVI and .WAV), editing the file doesn't require rewriting the entire file, and it can accommodate multiple elements and/or layers. For example, multimedia producers may need to mix many sounds into their final product, so they need to work with more than one layer of sound. Major partners with Microsoft in the development of the format include Adobe Systems, Avid Technology, Pinnacle Systems, and Truevision.

Advanced Basic Input/Output System—See **Advanced BIOS**.

Advanced BIOS—In IBM PS/2 computers with micro-channel architecture, the set of built-in instructions that lets computers operate in Protected mode. Protected mode allows an application to accommodate multitasking as well as to reserve RAM for use by a specific program. See **BIOS**. See **micro-channel architecture**. See **Protected mode**.

Advanced Configuration And Power Interface (ACPI)—A feature of Windows 98 and Windows NT 5.0 that gives the computer control over how much electri-city individual components use. For example, the computer could cut power to the modem or CD-ROM when they're not in use. On a larger scale, this will let users put their computers in a low-power sleep mode. Instead of shutting the computer off and sitting through a lengthy

reboot process the next day, users could put their PCs to sleep. Simply pressing a key on the keyboard or moving the mouse would "wake up" the computer, which would be ready for use immediately.

Advanced Graphics Port—See Accelerated Graphics Port.

Advanced Interactive eXecutive (AIX)—A proprietary IBM version of the Unix operating system. See Unix.

Advanced Research Projects Agency (ARPA)—Formerly the Defense Research Projects Agency (DARPA). A research agency responsible for exploring and funding technological possibilities, such as artificial intelligence and robotics. The agency changed its name when it began to investigate and endow non-defense research. See Advanced Research Projects Agency Net-work.

Advanced Research Projects Agency Network (ARPANet)—A worldwide network created in the 1960s that was maintained by the U.S. Department of Defense's Advanced Research Projects Agency to facilitate communication between research organizations and universities. ARPANet is considered the forerunner of the Internet.

Advanced Technology Attachment—See Integrated Drive Electronics.

Advanced Technology Attachment Packet Interface (ATAPI)—An extension to the Enhanced IDE (EIDE) interface that supports CD-ROM and tape drives, which were left out of the original EIDE and IDE standards. See Enhanced Integrated Drive Electronics.

AFIPS—See American Federation of Information Processing Societies.

AFS—See Andrew File System.

agent—An automated program, generally in the context of the Internet. These programs either gather information or perform a task for you without your intervention. An example would be services that check to see if specified Web pages have been updated. Agents include "bots," which can, for example, be set to gather news items of interest.

aggregator—A device that combines several Internet connections. Sometimes called a hub, although not to be confused with the networking device of that name. It can refer to a device that performs a whole host of functions, such as a hub that connects computers in a room or building to a central network, but also offers dial-up and leased-line access. An aggregator also can be a device that simply stores network routing information by combining the characteristics of several different routes into a single route.

aglet—Short for agile applet. Aglets are special Java applets that are completely portable and autonomous; you can even move them and then run them on another computer. Aglets can automatically decide when and where to move and under what circumstances. For instance, if the computer that an aglet is running on is disconnected from the network, it can wait until the computer is reconnected and then move elsewhere. It can create other aglets to go run on other computers: smaller aglets to perform specific tasks or entire copies of the aglet to run concurrently. See applets. See Java.

AGP—See Accelerated Graphics Port.

AI—See artificial intelligence.

AIFF—See Audio Interchange File Format.

AIX—See Advanced Interactive eXecutive (AIX).

alert box—In a graphical user interface, a box that displays a message to warn the user about a potential or real system error.

algorithm—A list of instructions that can be used to accomplish a task.

alias—An alternate name assigned to a computer, object, or group on a network. Aliases are handy when they replace a long name or a list of names. Many E-mail programs let users users assign an alias to lengthy and cryptic E-mail addresses. For example, a user could use "Joe and Sally" rather than josephwsmith @internet.college.edu.

aliasing—The effect of using a low-resolution graphics display, which results in jagged diagonal lines. See anti-aliasing.

alignment—In printing, lining up characters according to a particular point of reference, such as the left or right margin.

all points addressable (APA)—A graphics mode in which each pixel (tiny picture element) is acted upon individually, creating a sharper image.

alphabetic—Of an alphabet, such as the 26-letter English alphabet.

alphameric—See alphanumeric.

alphanumeric—Of both alphabetic characters and numerals. It also may include punctuation marks and special characters such as @, , or . Also called alphameric. See data type.**alpha channel**—In some 24-bit graphics adapters, an extra eight bits that control the 24 bits of color (eight bits for red, eight bits for blue, eight bits for green).

alphanumeric display terminal—A computer system capable of displaying alphanumeric characters only. Displaying graphics is impossible on an alphanumeric display except those formed by combining various letters, numbers, and symbols.

alphanumeric sort—A method of ordering data that accounts for alphabetic order, punctuation, and numerals. It often organizes data in the following order: punctuation marks, numbers, capital alphabetic characters, lowercase alphabetic characters, and any remaining characters.

A

alpha testing—In the development of hardware and software, the first stage of testing the final product. Alpha testing usually is conducted in-house by the company and may result in numerous changes to the product. Compare to **beta testing**.

alpha version—In the development of hardware and software, the product used in the first stage of testing. The alpha version of a product usually undergoes numerous changes before its final release. Compare to **beta version**. Compare to **demonstration program**.

alternating current (AC)—An electrical current that regularly and systematically reverses, or alternates, its direction of travel. The direction in which an electrical current flows is referred to as its polarity. One cycle, or hertz, is complete when the current has made two complete changes of polarity; in other words, the current has traveled both directions. A typical wall outlet transmits currents at 60 hertz per second. Compare to **direct current**.

ALT key—A key on a computer keyboard that, when used in conjunction with other keys, gives a key a function other than the one indicated by its label. For instance, employing the ALT-F key combination in most Windows applications will open the File menu. When using the ALT key, it is best to press the ALT key and, before releasing it, press the other key desired rather than trying to press both keys at the same time.

ALU—See **arithmetic logic unit**.

American Federation of Information Processing Societies (AFIPS)—(Pronounced A-fips.) An organization whose goals are to facilitate education and research and devise a system of standards for the computing industry.

American National Standards Institute (ANSI)—(Pronounced An-see.) An organization within the federal government that has the goal of standardizing computer systems for trade and communications purposes. COBOL, FORTRAN, and C programming languages are ANSI standards. ANSI works with the International Organization for Standardization (ISO). See **International Organization for Standardization**.

American National Standards Institute/Standards Planning and

ASCII Characters

Dec.	Char.	Dec.	Char.	Dec.	Char.	Dec.	Char.	Dec.	Char.
0	NUL (Null)	26	SUB (Substitute)	52	4	78	N	104	h
1	SOH (Start of heading)	27	ESC (Escape)	53	5	79	O	105	i
2	STX (Start of text)	28	FS (File separator)	54	6	80	P	106	j
3	ETX (End of text)	29	GS (Group separator)	55	7	81	Q	107	k
4	EOT (End of transmission)	30	RS (Record separator)	56	8	82	R	108	l
5	ENQ (Enquiry)	31	US (Unit separator)	57	9	83	S	109	m
6	ACK (Acknowledge)	32	<space>	58	:	84	T	110	n
7	BEL (Bell)	33	!	59	;	85	U	111	o
8	BS (Backspace)	34	"	60	<	86	V	112	p
9	HT (Horizontal tab)	35	#	61	=	87	W	113	q
10	LF (Linefeed)	36	$	62	>	88	X	114	r
11	VT (Vertical tab)	37	%	63	?	89	Y	115	s
12	FF (Formfeed)	38	&	64	@	90	Z	116	t
13	CR (Carriage return)	39	'	65	A	91	[	117	u
14	SO (Shift out)	40	(	66	B	92	\	118	v
15	SI (Shift in)	41	)	67	C	93	]	119	w
16	DLE (Data link escape)	42	*	68	D	94	^	120	x
17	DC1 (Device control 1)	43	+	69	E	95	_	121	y
18	DC2 (Device control 2)	44	,	70	F	96	`	122	z
19	DC3 (Device control 3)	45	-	71	G	97	a	123	{
20	DC4 (Device control 4)	46	.	72	H	98	b	124	|
21	NAK (Negative acknowledge)	47	/	73	I	99	c	125	}
22	SYN (Synchronous idle)	48	0	74	J	100	d	126	~
23	ETB (End transmission block)	49	1	75	K	101	e	127	DEL
24	CAN (Cancel)	50	2	76	L	102	f		
25	EM (End of medium)	51	3	77	M	103	g		

Requirements Committee (ANSI/ SPARC)—A division of ANSI that devised a standard architecture for database management systems.

American Standard Code for Information Interchange (ASCII)—(Pronounced ask-key.) A system of computer coding (see chart, previous page) in which all values, including letters and punctuation, are given seven- or eight-digit binary values. In the ASCII character set (the conglomeration of all 256 possible values), the first 32 values are reserved for communication and printing information, including DELETE, TAB, and ENTER. The next 96 values are reserved for letters (both uppercase and lowercase), numbers (0 to 9), and common punctuation. These first 128 characters are known as the standard ASCII character set. The final 128 values, known as the extended ASCII character set, are reserved for commands dictated by a manufacturer or programmer. These usually include, but are not limited to, special characters such as ®, , and . ASCII is the most widely used coding system in the world. Although the character set is not large enough to accommodate symbols and letters for all languages, some non-English speaking countries have adapted the ASCII character set to their own needs. Most word processing programs allow users to save documents in ASCII format, a good idea when transferring files between different programs because this standard is universal. Compare to **Unicode**. See **extended ASCII**.

AMLCD—See **active-matrix liquid-crystal display**

amp—See **ampere**.

ampere (A)—The unit for measuring electrical current; current measures the amount of electric charge flowing through a conductor at a given time. An ampere is the charge of one coulomb (a unit of electric charge equal to 6.25 X 10 to the 18th electrons) passing a point in one second.

amplitude—The height of the peaks and depths of the troughs in a wave, such as a sound wave, light wave, or electrical current. In reference to electrical current, amplitude usually is measured in volts.

analog joystick

analog—Refers to an electronic device that uses a system of unlimited variables to measure or represent the flow of data. Radios, for example, are analog because they use variable sound waves to carry the data from the transmitter to the receiver. In contrast, digital electronic devices use a limited, predetermined numbering system to measure or represent the flow of data. Think of digital as a staircase and analog as a ramp. An analog value can be at any height along the ramp. A digital value can only be at a height that matches a stair step. Modern computers are digital because they use the fixed binary digits 0 and 1 to represent all data. Compare to **digital**.

analog channel—A path upon which information travels in analog form. See **analog**.

analog computer—A mechanism that processes analog data transmissions rather than digital data transmissions. A PC can process analog data transmission using an analog-to-digital converter. Most analog computers are used for scientific and industrial purposes. See **analog**. See **digital**.

analog data—Information transmitted in a form that varies continuously within a certain range, such as sound in a sound wave, rather than in discrete increments, such as digital data. See **analog**.

analog display—See **analog monitor**.

analog joystick—A joystick that transmits information to the computer via an analog signal. The analog signal relays the joystick position by sending different amounts of voltage back to the computer. The computer measures the amount of voltage to determine the joystick position. Voltage changes also can be used to signal when buttons on the joystick are pressed. See **analog**. See **digital**. See **digital joystick**.

analog line—A communications pathway on which information is transmitted in analog form. See **analog**.

analog monitor—A terminal capable of displaying an infinite range of colors, compared to a digital display that can only produce a finite range of preprogrammed colors. A VGA display, for example, is analog. Compare to **digital monitor**.

analog phone line—A phone line that uses a conventional analog signal to transfer voice or data signals, often referred to as a Plain Old Telephone Service (POTS) line. Sound waves are translated into an electronic signal that is deciphered by measuring changes in the signal's attributes, such as frequency and amplitude. Analog phone signals can only perform one function at a time: they can be used to place a regular phone call or to carry data from one modem to another. They also are much slower than digital phone lines, speeds on analog phone lines are limited to about 35 kilobits per second (Kbps). The 56Kbps modems in use today transmit a digital signal over analog phone lines and take advantage of a digital phone line at the remote end to improve speed. Analog phone lines use standard, modular phone jack connectors with four wires and four grooves. The four wires can be used to carry two separate phone lines on two wires each. Digital phone lines typically have six to eight wires and larger connectors with six to eight grooves. See **amplitude**. See **analog**. See **digital**. See **frequency**.

analog signal generator—Any mechanism that produces analog data signals. The mechanism that positions a voice-coil actuator is one example of an analog signal generator. Because its movement is controlled by analog signals, the voice-coil actuator moves with more fluidity—and thus more efficiently—

A

over the surface of the disk than a stepper motor, which moves in discrete increments. See **analog**.

analog-to-digital converter (ADC)—A device that converts an analog signal into digital data so the data can be retrieved from an analog device. An ADC translates audio sounds, such as a spoken word or a musical score, into electronic data that can be stored on an electronic storage device, such as a hard drive or tape drive. The converter can be used in conjunction with an analog computer, such as a tire-balancing computer at a mechanic's shop or with some voice-recognition applications. Also called A-D converter.

analytical engine—A theoretical mechanical computing device devised by Charles Babbage in 1832-33, on which mathematical operations could have been performed, logical problems could have been solved, and information could have been stored. He only built a small portion of the machine, but the ideas were instrumental in the design of future computing machines.

anchor—A Hypertext Markup Language (HTML) tag used to establish a hyperlink to another page. The simplest type of anchor, such as <a href://www.Smart Computing.com> Smart Computing just sends the viewer to another site. Anchors also can be used to send the viewer to a specific spot in another file, to start an E-mail session, jump to a File Transfer Protocol (FTP) site, and more. In desktop publishing, an anchor also is used to keep objects in a particular place or alongside specified content. For example, you can use an anchor to keep a picture with the text that refers to it regardless of changes. See **Hypertext Markup Language**.

Andrew File System (AFS)—A client/server system for sharing files over a Transmission Control Protocol/Internet Protocol (TCP/IP) network. The file system, primarily used on Unix workstations, was developed at Carnegie Melon University and named after one of the university's founders. With AFS, anyone with an account on an AFS server can log into that server from any machine with the AFS client software and retrieve files from or save files to the server. AFS is considered an improvement over the Network File System (NFS), another standard client/server system. Among the benefits AFS's developers tout are improved speed, easy maintenance, and reliability. AFS also increases network performance by using the client computer's hard drive as a cache to store frequently used network files. Reading files from a local hard drive increases performance compared to fetching them from a server and it also reduces network traffic. See **Network File System**. See **Transmission Control Protocol/Internet Protocol**.

angstrom (A)—One 10-billionth of a meter.

animation—The depiction of motion produced by rapidly displaying a successive series of slightly altered images. Computers have affected the animation industry greatly because they allow an image to be slightly altered instead of completely redrawn.

anode—A positively charged point toward which electrons in an electronic device flow.

Anonymous File Transfer Protocol (Anonymous FTP)—A service available at some Internet sites that gives any user access to data files and applications using a standard of data transmission called FTP, which allows one user to download data files from another computer using an Internet or network connection. Anonymous FTP received its name because users don't need a special password to retrieve the files. The files are available to the public, and anyone can download them using an E-mail address and a sign-in name.

ANSI—See **American National Standards Institute**.

ANSI/SPARC—See **American National Standards Institute/Standards Planning and Requirements Committee**.

answer mode—A modem setting that allows it to answer incoming telephone calls. It emits an answering signal to indicate it has received a call.

answer-only modem—A modem that can answer incoming telephone calls but cannot initiate calls.

answer/originate modem—A modem that can answer and initiate telephone calls. Most modems are answer/originate modems.

anti-aliasing—The process of eliminating jags, the rough edges of a diagonal line or curve caused by low-resolution dot-matrix image production. All computer graphics are produced by dot matrices, but jags can be smoothed in a bit-mapped format by employing a higher-resolution image display or by shadowing contiguous pixels (tiny picture elements) to present the image of a smooth line. Also called dejagging.

anti-glare screen—An add-on device made from polarized material that can be placed in front of a monitor's screen to reduce glare and prevent eyestrain.

antistatic device—Any device that minimizes static electricity, such as an antistatic mat.

antistatic mat—A floor mat that minimizes static electricity.

antivibration mount—Anchors a hard drive to a computer's chassis. By anchoring the hard drive, its read/write heads are protected from being jarred by vibrations inevitably created by the drive's operations and the operations of other devices inside the computer's case.

antivirus program—Software that monitors a computer for viruses by looking for irregularities in a computer system and then comparing its findings to a database of virus information. Viruses not included in the antivirus program's database will go undetected, so it is important to periodically update antivirus programs with information

Chicago Cube

anchor

about new viruses. Such updates usually can be purchased on a subscription basis from the company that produced the antivirus program. The regular use of an antivirus program often can eliminate a virus before any damage is caused. Antivirus applications should be used when foreign software is introduced into a computer.

any key—Any key that can be pressed on a keyboard. When a program indicates that any key should be pressed, it is telling the user to press any of the keys on the keyboard to continue.

APA—See all points addressable.

Apache server—Free, public domain software for running World Wide Web servers. The name is a reference to the software's origins—it was based on software developed by the National Center for Supercomputing Applications (NCSA) and a number of patches. Thus, it was "a patchy server." Because it's free and has a reputation for strong performance, Apache is the most popular Web server software. A January 1998 survey by Netcraft estimates Apache is installed on more than 50% of the world's Web servers. While Apache is geared primarily toward Unix servers, it also has been ported to Windows and OS/2.

APCUG—See Association of PC User Groups.

aperture grill—Used in Trinitron monitors in place of a shadow mask for separating phosphors. Aperture grill monitors use a series of thin, closely-spaced vertical wires to isolate pixels. The method was an improvement over the shadow mask, which tended to warp with age and distort the image, but sturdier shadow masks have been developed. Because aperture grills block less of the screen and do not interrupt the screen vertically, the image is brighter and more vibrant. See phosphor, compare to shadow mask.

API—See application program interface.

app—See application.

Apple key—A proprietary key on Apple keyboards that has the outline of an apple on it and is used in conjunction with other keys to perform certain preprogrammed functions. The Apple key is similar to the ALT key on the PC keyboard.

Apple Macintosh—A 32-bit computer first introduced in 1984. Macs have been popular

Apple Macintosh

with schools and families primarily because their graphical user interface made them easier to use than DOS-based PCs. Ironically, its ease of use led many to disregard it as a "serious" computer. This was one factor allowing the DOS-based IBM PC and compatible computers to gain a foothold in the business market even though many people considered them much more difficult to use than the Macintosh. Most of today's IBM-compatible computers use a graphical user interface (GUI) such as Windows that mimics many of the features pioneered by the Macintosh operating system.

applet—A small niche application or utility, such as a mortgage calculator program, that performs just one useful task and is designed for use within larger programs. Because of their small size, many applets are available as free software online. See Java.

application (app)—An executable program capable of performing a specialized function other than system maintenance (which is performed by utilities). Games, educational programs, and communications software are all examples as are word processors, spreadsheets, and databases. Also called software.

application developer—The individual or company that devises the idea for a program, specifies its functions, and designs the layout. The developer does not necessarily write the programming code.

application file—A collection of information that runs a program that allows the user to perform a specific function such as word processing or using a spreadsheet. A user-created file, such as a specific text document, is created through an application file.

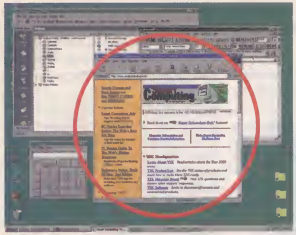
application icon—A small picture or image that represents an application or utility in a graphical user interface such as Microsoft Windows. Clicking or, in most cases, double-clicking the icon will start the program. Icons also can represent other items such as folders.

application processor—A processor that speeds an application's functions by eliminating unnecessary tasks. An application processor is designed or reserved for use with a certain application.

application program—See application.

application program interface (API)—A connection point at which information is transmitted between a software application and the operating system. For an application to run smoothly, certain maintenance services, such as file management functions, must be performed. The application communicates the need for these services to the operating system over an API.

application icon



application window

application programmer—An individual who writes programming code for a software application. Programmers eliminate bugs from a program and correct programming errors, so they are responsible for an application's technical performance. See **programmer**.

application shortcut key—See **shortcut key**.

application software—See **application**.

application-specific integrated circuit (ASIC)—A processing chip originally designed for multiple functions that is permanently set during manufacturing to perform one certain function. Although this allows for the optimum performance of that function, much of the chip remains unused. ASICs are found in home electronic devices such as VCRs and television sets, in automobiles, in computers, and in industrial machines.

application window—The enclosed rectangular or square portion of a computer screen that displays a program. In operating systems such as Microsoft Windows and the Macintosh OS, application windows can be made smaller or larger by the user. Windows also can be placed side by side or on top each other so information can be dragged with the mouse from one window to the next.

Archie—An online system created to compile and index information for easy retrieval. Archie originated at the McGill University School of Computer Science, where all the anonymous File Transfer Protocol (FTP) sites on the Internet at the time were organized into one list for easy browsing. Since then, Archie sites have been used to catalog all sorts of information on the Internet, from reams of music lyrics to journals of scientific discoveries. Archie is accessible through various Internet sites. To find one, search for the keyword "Archie" with an Internet search engine.

architecture—The design of a computer system, hardware component, or operating system. Architecture refers to the entire structure and the information that makes it functional. Software applications usually are not considered a part of this system because they most often only perform a task and are not responsible for making a hardware component run. The most often discussed architecture is microprocessor architecture.

archival backup—A backup routine in which only the files that have changed since the last backup are saved. Archival backups save time because not all data are saved, and they generally are used more frequently than a full backup. Archival backups, however, aren't a substitute for the full backup, or a backup that will be stored for a long time. Media that have been archived will be good for an undetermined period of time. Eventually, the backup will become unstable because the media on which material is written will decay. Also called incremental backup. See **backup**.

archive attribute—A DOS and OS/2 characteristic that denotes files that have changed since the last system backup. When an archival backup is performed, a computer will save only marked files.

archive bit—A single data bit that indicates whether a file has been changed since the last archival backup. If a file's archive bit indicates no change has occurred, the backup program will not resave the file. The previous backup's copy should be an exact match.

archive copy—See archive file.

archive file—A data-file copy stored somewhere other than the location of the file from which the copy was made. An archive copy helps ensure against permanent data loss, which may occur in cases of system failure or natural catastrophe. Backing up files to a diskette or a tape drive is one method of archiving data. Extremely valuable archives often are stored in fireproof vaults, underground bunkers, or at sites hundreds of miles from the original data source.

ARCnet—See **Attached Resources Computer network**.

areal density—The amount of information that can be packed into an area of storage media, whether diskette, hard disk, or optical disc, generally measured in bits per square inch. The figure is handy for comparing the capacities of different storage media. Advances in technology have led to devices with higher and higher areal densities. From IBM's first hard drive, which could fit 2,000 bits per square inch, drives have progressed to the point that today's hard drives can fit hundreds of millions of bits of data or more into each square inch.

arithmetic logic unit (ALU)—The part of the computer's CPU that carries out mathematical, logical, and comparative operations. Numbers are sent to the ALU, the desired functions are performed, and the results are sent to a memory storage area.

ARP—See **Address Resolution Protocol**.

ARPA—See **Advanced Research Projects Agency**.

ARPANet—See **Advanced Research Projects Agency Network**.

array—A term in programming used to describe a group of related data values. Arrays are composed of data all the same size and type. Programs can access data in arrays through addresses composed of the array's name and an indexing number or numbers. For example, many arrays are two-dimensional table-like structures. Address Z (3,4) might refer to the data in the array

named Z that is three columns over and four rows down.

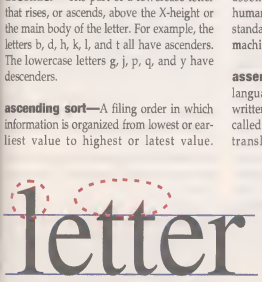
array processor—A conjoined set of identical processors operating under the direction of a single primary processor. An array processor usually is reserved for a specific function or functions.

arrow keys—On a keyboard, the keys imprinted with arrows, each indicating a specific direction, that often control on-screen cursor movement or select among menu choices. The 2, 4, 6, and 8 keys on the numeric keypad can be used as arrow keys on some keyboards when the Number Lock function is off.

artificial intelligence (AI)—The ability of a computer to "think" for itself. AI studies usually focus on understanding how humans think and how these capabilities might be instilled into a computer. Various areas of AI include speech recognition, deductive reasoning capabilities, creativity, and the ability to learn from experience (as opposed to memorizing data). AI has incredible potential, from electronically diagnosing health problems to analyzing business markets and suggesting advertising techniques. However, science has a long way to go before the kinds of thinking machines featured in futuristic movies and books are a reality. Although computers can excel at certain tasks such as beating people at chess, they still are only tools.

ascender—The part of a lowercase letter that rises, or ascends, above the X-height or the main body of the letter. For example, the letters b, d, h, k, l, and t all have ascenders. The lowercase letters g, j, p, q, and y have descenders.

ascending sort—A filing order in which information is organized from lowest or earliest value to highest or latest value. Examples include a numerical sort from one to 10 and an alphabetical sort from A to Z.



ASCII—See **American Standard Code for Information Interchange**.

ASCII character set—See **American Standard Code for Information Interchange**.

ASCII file—A text file constructed of ASCII characters only. Because it contains no formatting information, the data can be easily transferred between applications.

ASCIIZ string—A series of ASCII values ending with the ASCII null character, usually zero (0). For example, 01001000 01101001 00100001 00000000 is binary code for the ASCII configuration of "Hi!". The last eight zeros are the binary code for the ASCII null character.

ASF—See **Active Streaming Format**.

ASIC—See **application-specific integrated circuit**.

ASP—See **Active Server Page**.

aspect ratio—The ratio of width to height of a computer screen or image area. This ratio is used to determine proportions for printing, downloading, or transferring graphical data.

assembler—A program that translates assembly language understandable by humans into the machine language understandable by CPUs. See **assembly language, machine language**.

assembly language—A programming language that allows an application to be written using English syntax. An application called an assembler must then be used to translate the assembly language into machine language that the computer can understand. (The code can be translated back into an assembly language with what's called a disassembler.) Assembly languages are easy to use and give the programmer more control over the creation of an application, but they cannot be easily converted or transferred from one computer system to another. Compare to **machine language**.

assignment statement—A programming command that designates a specific value for a variable.

associated document—A data file linked to a certain application. See **association**.

association—A link between an application and a data file that allows the file to be opened and manipulated by the application. In operating systems such as Windows 95 and DOS, a three-letter file extension is used to designate the files that are linked to a certain application. For example, Microsoft Word opens data files with a .DOC file extension; in other words, there is an association between Word and .DOC files. Associations usually are created between a data file and the application that created it.

Association for Computing Machinery (ACM)—An international educational and scientific organization with the purpose of promoting technical knowledge and skill in the field of information technology.

Association of PC User Groups (APCUG)—An international organization with the purpose of facilitating interaction among PC user groups.

associativity—See **operator associativity**.

asterisk—The name of the * character on computer keyboards, usually engaged by pressing the SHIFT-8 key combination. The asterisk represents multiplication in mathematical expressions and often is used as a "wildcard" variable for data file searches. For example, a search for the file *.doc with Windows' Find File program finds every file that ends with the .DOC extension in the designated directory or drive; a search for the file Setup.* would find in the designated directory or drive every file labeled "Setup" regardless of its file extension; and a search for the file *.* would find every file in the designated directory or drive. See **wildcard character**.

Asymmetric Digital Subscriber Line (ADSL)—A Digital Subscriber Line (DSL)

A

on which data flows in (downstream) faster than it goes out (upstream). ADSL speeds range from 1.5 megabits per second (Mbps) to 6Mbps downstream and 64 kilobits per second (Kbps) to 384Kbps upstream. These rates reflect the fact that Internet use requires more downstream than upstream bandwidth, since loading Web pages is a downstream activity. Someone running a Web server, however, also would need a wide upstream pipe. ADSL also has become a generic reference to all DSL lines, even though it is quite different than the other types of DSL lines. See **bandwidth**, **Digital Subscriber Line**.

asymmetrical transmission—A type of communications link in which the connection is split into two channels of unequal size. This allows for the simultaneous reception and transmission of data. Most modems today use asymmetrical transmission methods. The smaller channel is reserved for smaller data files, while larger files are assigned to the bigger higher-speed channel. The small channel sometimes is called the narrowband channel, and the large channel is known as the broadband channel.

asynchronous cache—A type of Level 2 (L2) cache that is not synchronized with the computer's internal clock. This technology is slower than the new standard, pipeline burst cache, and is only used in 486 series and older computers. Compare to **pipeline burst cache**. See **Level 2 caching**.

asynchronous communication—See **asynchronous transmission**.

asynchronous device—A mechanism whose internal functions are not coordinated with the timing of another system function. Many analog computers are asynchronous devices because they depend on external stimuli rather than internal signals to initiate a function.

asynchronous operation—Any computer function that runs exclusively of any timing device. For example, a command that remains dormant until a certain key is pressed is an asynchronous operation.

Asynchronous Transfer Mode (ATM)—A super-fast network communications system that can transfer data at speeds of 155 or 622 megabits per second and faster. To achieve these speeds, data are divided into small packets of information that are sent along the fastest possible route. ATM is expected to be a widespread future network system with speeds approaching 10Gbps.

asynchronous transmission—Communication in which data bits don't need to wait for a certain event or time to be transmitted. Telephone communication is one example because both parties can speak at the same time. Synchronous transmission, on the other hand, occurs at regular, structured intervals. Most of the communication between a computer and a device, such as a printer or a modem, is asynchronous; communication within a computer system generally is synchronous because it is regulated by the microprocessor. Because of the freedom involved in asynchronous transmissions, a computer system must determine the starting and stopping points of a string of transmitted data with data bits known as start and stop bits. Compare to **synchronous transmission**.

ATA—See **Integrated Drive Electronics**.

ATA committee—An American National Standards Institute (ANSI) committee responsible for drafting standards for the ATA, also known as Integrated Device Electronics, devices. By publishing standards, the committee helps ensure the compatibility of similar devices built by manufacturers around the world. See **American National Standards Institute, Integrated Device Electronics**.

ATAPI—See **Advanced Technology Attachment Packet Interface**.

AT attachment—See **Integrated Drive Electronics**.

AT bus—The main electronic pathway used to connect IBM AT and compatible computer motherboards to the various system components. The AT bus is a 16-bit bus, which means it can send 16 bits of data at one time. This was an improvement over the original eight-bit IBM PC bus. See **bus**.

AT command set—In communications, a group of instructions that activate certain functions on a modem. Although the AT command set originally was developed for the Hayes modem, it has become the standard for all modems. An example of an AT command is the command ATDT, which initiates touch-tone dialing; ADTP initiates pulse dialing.

AT keyboard—A standard 84-key keyboard used with the IBM AT computer. IBM later introduced the 101-/102-key keyboard, which included two function keys, extra CTRL and ALT keys, and four arrow keys, among other additional keys. The 101-/102-key keyboard, also known as the Advanced Keyboard by IBM and the enhanced keyboard, has become the standard. A 104-key keyboard, a slight variation of the 101-/102-key keyboard that is specially designed to accommodate the Windows 95 operating system, became popular in 1996.

atomic operation—A computer function that must be performed all at once with no divisions. If an atomic operation is cut short, it must be restarted from the beginning.

attached processor—An auxiliary processor connected to a computer system. The attached processor usually performs a specific function vital to the performance of many system operations. The processor chip of a video card is an attached processor.

Attached Resources Computer network (ARCnet)—The first commercially available local-area network (LAN) developed by Datapoint Corp. in 1977. ARCnet uses coaxial cables to connect a wide variety of computers. At its fastest, ARCnet could transfer 2.5MB of data per second. ARCnet has a network capacity of 256 computers, fewer than other popular networks such as Ethernet. ARCnet is used today primarily for small offices with only a few workstations.

attenuation—The natural atrophy of a transmitted signal as it travels from its source.

audio—Relating to anything that can be heard or produces an audible sound, usually a signal between 15 hertz and 20,000 hertz, the range of human hearing. In a multimedia computer, audio typically is produced in three ways: a CD-digital audio format,

which operates like a typical audio CD player; a format like Microsoft Corp.'s wavetable synthesis (WAV) format, which plays back pre-recorded sounds using a digital-to-audio converter; and a Musical Instrument Digital Interface (MIDI) format, which processes data from a MIDI device such as a synthesizer. Audio capabilities are found on multimedia computers. See **Musical Instrument Digital Interface**, **wavetable synthesis**.

audio card—See **sound card**.

Audio Interchange File Format (AIFF)—A file format for sound files originally developed by Apple for Macintosh computers, sometimes called the Apple Interchange File Format. The format is like other sound formats in that it stores audio in digital form. It's an uncompressed format, however, which means sound quality will be good, but files will take up a lot of disk space. On Windows computers, the Windows Media Player and QuickTime will play AIFF files, which will appear with an .AIF file extension.

audio output port—A device that converts digital data into an audible sound.

audio response—Any sound produced by a computer in reply to data input. An audio response might be as simple as a beep or as complex as a digitized voice.

audio streaming—Audio files that are played in a continuous stream over the Internet. Streaming Web files requires the use of plug-ins, which automatically decompress the files and play them in real time. Users can begin playing the file before the file's data has been completely transmitted. See **real time**.

audiovisual—Anything that uses sight and sound to present information.

audiovisual interleaving (AVI)—A way of presenting a motion-picture video in an application window on a Video Graphics Array (VGA) or better monitor. AVI files have an .AVI file extension. To view them, some type of .AVI file player must be present on the system.

audit—A diagnostic examination of the complete computer system to examine system performance, check for viruses, and look for any other problems.

audit trail—A documented record of the path data travel from the moment data enter a computer system to the time data are released as output. Audit trails are especially helpful for keeping track of changes made to files on a network and to financial transactions in an accounting application.

authentication—In networks, the procedure by which a computer verifies user identification. The most common form involves the comparison of a logon name and password to a stored file of approved usernames and passwords. Any differences between the two will prohibit the user from accessing the information.

authoring language—Any computer language primarily used to design databases and create programs. What qualifies as an authoring language has been debated by the computer industry and programmers for many years. Some consider only the primary programming languages, such as Assembler, C, C++, Pascal, and COBOL, to be authoring languages; others broaden the definition to include programs such as FoxPro, Visual BASIC, and dBase IV; still others include even macro languages, including the languages used in Microsoft Excel and Lotus 1-2-3.

authoring program—See **authoring system**.

authoring system—A set of high-level computer applications designed to facilitate the coding and formatting of software applications. In addition to an authoring language, an authoring system includes the software needed to completely develop a program. An authoring system is especially useful when incorporating a number of multimedia files, which contain both video and audio features, into a single application.

authorization code—A password that for security reasons verifies the identification of a user of an application, computer, or network.

Autoexec.bat—The abbreviated form of automatically executed batch file. In the DOS operating system, batch files list DOS commands to be performed sequentially whenever the batch file is run. Such files save the operator from haying to type frequently used commands over and over. The Autoexec.bat file is a special batch file placed in the system's root directory that is automatically executed each time the computer boots. An Autoexec.bat file is not necessary in a DOS computer, but most systems have at least a simple Autoexec.bat file. Some software used on a computer might need certain Autoexec.bat commands to function correctly. Such commands often are placed into Autoexec.bat automatically when the program is installed. Autoexec.bat is a text file that can be edited with any text editor such as Windows' Notepad. Knowing what the commands in your Autoexec.bat file do can help you to fine-tune your computer system.

autofeed—To automatically feed something. When used in the context of computers, it generally refers to feeding paper into a printer or scanner. Autofeed can use various mechanisms, from tractor-fed paper (used mostly in dot matrix printers) to large paper trays. The point is that you don't have to manually feed individual pieces of paper to the machine.

automatic data processing (ADP)—See **data processing**.

autorestart—A feature of some operating systems that allows a computer to shut down and reboot automatically after the occurrence of certain errors.

autosave—A feature of some applications that automatically records, at periodic intervals, changes made to a file. The changes are saved to a temporary file that can be retrieved. Autosave helps prevent accidental data loss.

AUX—See **auxiliary device**.

auxiliary device (AUX)—A peripheral (such as a printer or modem) that is not necessary for the operation of a computer but often is useful. Also called accessory.

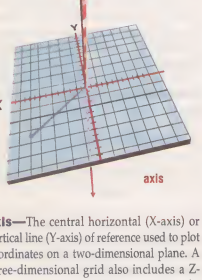
auxiliary equipment—See **auxiliary device**.

A

avatar—Refers to the "superuser" or system administrator of a Unix system. After a user is logged on as the avatar, the user can work on any directory or file on the network. Also called a root. Also refers to a three-dimensional design used to represent the physical self often used in virtual chat rooms found in Internet relay chat (IRC) sites on the Internet.

AVI—See audiovisual interleaving.

awk—A programming language used for filtering and manipulating text. The language, used primarily on Unix workstations, is named for its authors, Alfred Aho, Peter Weinberger, and Brian Kernighan. Perl has supplanted awk as the pre-eminent programming language for text manipulation. Several awk versions are available, and their authors generally identify themselves with a letter in front of "awk". Gawk, for example, is the offering from the Free Software Foundation's public-domain GNU collection. See **Practical Extraction and Report Language**.



axis—The central horizontal (X-axis) or vertical line (Y-axis) of reference used to plot coordinates on a two-dimensional plane. A three-dimensional grid also includes a Z-axis to represent depth. See **X-axis**, **Y-axis**, **Z-axis**.

B

B:—When followed by a colon, B refers to the B: drive, the second diskette or hard drive on a network or inside a computer. On many PCs, the B: drive is a 5.25-inch diskette drive or a 3.5-inch diskette drive, but this can be changed by the user.

backbone—The part of a network that carries the majority of the data traffic. Backbones connect smaller networks, or nodes, together to create larger networks. Backbones usually transmit data at higher speeds than the rest of the network. On large networks, such as the Internet, there may be more than one backbone, all of which span long distances. On smaller networks, the backbone sometimes is called the bus.

backdrop—See **wallpaper**.

back end—A generalized term that has come to mean a variety of programs and processors that receive data submitted by front-end applications or processors and return the results. For example, a database might have a front end where users write queries. The front end takes the search terms and hands them off to a back-end program that actually runs the search and gives back the results. The front-end machine might then display the results in a more user-friendly format. Compare to **front end**.

back-end processor—On a network, workstation computers sometimes are called front ends, and server computers sometimes are called back ends. A back-end processor is responsible for performing processor-intensive work for various network applications. See **network**. See **server**.

background—In multitasking environments such as Microsoft Windows, several applications can run simultaneously. One runs in the foreground while the others run in the background. The application or window in the foreground is active and can accept user input with a mouse, keyboard, or other device. Applications in the background cannot accept user input, but they still can run internal processes such as printing, reading and writing data to the hard drive, or performing calculations. In Windows, users can move background applications to the foreground by pressing the ALT-TAB key combination or by clicking a background window. Background also can refer to the color of the screen in DOS or Windows environments. Background colors can be selected according to the user's preference.

background noise—In communications, background noise refers to unwanted and nearly ever-present "static" inhabiting lines and circuits. Excessive background noise can interfere with data transfer.

backlighting—The illumination of liquid-crystal display (LCD) screens by shining a light from the inside out. Backlit LCDs are clearer and easier to read than other screens. See **liquid-crystal display (LCD)**.

backscroll buffer—A portion of memory used to store information outside the current window when you use the scroll bar to scroll back through a window. See **scroll bar**.

backslash—The name of the "\" character on computer keyboards. Backslashes are used mainly in DOS, where they separate the names of subdirectories. Compare to **forward slash**.

BACKSPACE key—A key, usually in the upper-right corner of the main section of the keyboard, that causes the cursor to move back one position. In word processing programs, the BACKSPACE key often erases the character immediately preceding the cursor, while the DELETE key erases the character following the cursor. Also called the RUBOUT key.

back up—To copy a file or files to an alternate location so a safe copy remains if the original is destroyed or damaged. A single file or an entire drive can be backed up if media of sufficient size are available. Because of their large capacity, magnetic tape drives often are used for backing up information. Backup programs often save files in a compressed format that occupies less space on the backup media. This means that to view the backed-up files, the program that backed them up must be used to restore them to their original form. See **restore**.

backup—A copy of a file or files created in case the original is destroyed or damaged. It is always a good idea to make backups of important files. See **full backup**. See **incremental backup**.

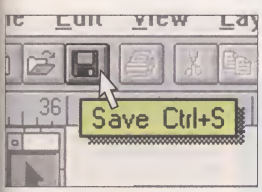
backup server—A server used in conjunction with a primary server to make sure there always is a second copy of everything

on the network. Also called shadow server or mirrored server. See **server**.

backward-compatible—The ability of new devices or programs to recognize and make use of existing devices, programs, or data. One hardware example is computers based upon Intel Corp.'s Pentium processor, which can run nearly all the software written for previous computers based on other Intel CPUs such as the 80386 and 80486. In software, backward-compatible usually denotes the ability to read data created by previous versions of the same software. For instance, Microsoft Word 7.0 can open and edit documents created in Microsoft Word 6.0. Also called downward compatible. Compare to **upward compatible**.

bad sector—An area on a diskette or hard disk not fit for use because of a flaw or manufacturing defect. Many hard disks contain a few bad sectors; programs and commands such as MS-DOS' FORMAT can identify them and make sure they are not used to store data. Bad sectors appearing where they previously did not exist could indicate a hard disk problem that should not be ignored.

.BAK—A DOS file extension used to denote a backup file.



balloon help

balloon help—A help system featured in many applications that uses small pop-up "balloons" of text that appear when the cursor is moved over certain spots in an application's interface. The balloons usually describe the function of a button on a toolbar. Similar to tool tips, which are rectangular pop-up help words that appear in many Windows-compatible programs.

ball printer—A type of printer that uses a metal ball-shaped print head that has characters affixed to its surface. The printer rotates and positions the print ball and strikes it against a ribbon to print. The printer is limited to printing only those characters on the print ball.

band—A range of frequencies between a high and low limit. For example, a communications device might transmit data in a 20 megahertz (MHz) band between 10MHz and 30MHz.

bandwidth—The capacity a network or data connection has for carrying data. For analog transmission, bandwidth is the difference between the upper and lower transmission frequencies in a given range. It is measured in cycles per second or hertz (Hz). For digital transmission, bandwidth is measured in bits per second (bps), and the larger the bandwidth number, the faster the digital transmission. This speed is important for input/output devices because a bus with a low bandwidth could restrain a faster I/O device from performing at full capacity.

bank—Similar electronic devices grouped together in a machine. The term most often is used to describe RAM, which must be installed in full banks to function properly. In some machines, a bank is made up of one single in-line memory module (SIMM), but in others a bank could be two or four SIMMs. If a computer requires banks of four SIMMs and only three are installed, the computer will not recognize any of the memory in the incomplete bank.

bar chart—A type of graphical chart in which data are displayed by bars stacked on top of each other or side by side. Comparing the relative lengths of the bars allows readers to quickly understand the relationship between sets of numbers.

bar code—A standardized system of representing data in the form of parallel lines of different widths and spacings. With the correct equipment, a computer can read bar codes, which often are used to identify objects for inventory and to track shipments. One everyday use of bar codes is at the grocery store, where nearly every package includes a bar code that computerized cash registers use to find price information and to update inventories.

barrel distortion—A type of distortion on a computer monitor in which the left and right sides of the screen bend out, away from the center of the monitor. The top and bottom of the screen would be narrower than the middle. Compare to **pincushion distortion**.

base 2—See **binary**.

base 8—See **octal**.

base 10—See **decimal**.

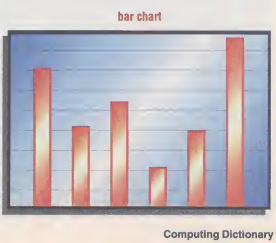
base 16—See **hexadecimal numbering system**.

base address—A certain memory address from which other addresses can be determined. For example, if location 6000 is set as the base address, or address one, location 6005 could be the base plus five. Computers use memory addresses to keep track of where information is stored.

base memory—See **conventional memory**.

base RAM—A synonym for base memory, or in some cases a reference to the amount of RAM built into a computer's motherboard. For example, some 486-based computers come with 4MB of RAM hard-wired into the motherboard.

bar chart



baseband transmission—Communication in which the wire or line carries one signal at a time. Most computer communication is baseband. Compare to broadband transmission.

baseline—An imaginary line with which typed letters are aligned. The bottom of a letter usually touches the baseline. Descenders, such as the bottom of a "j," drop below the baseline.

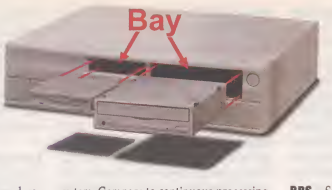
BASIC—Beginner's All-purpose Symbolic Instruction Code, a programming language using common words so as to be easily understandable. The original BASIC, often used in schools as an introduction to programming, was most popular in the 1970s and early 1980s.

Basic Input/Output System (BIOS)—(Pronounced bye-ose) A special piece of software built into most computers. BIOS routines control the startup process of the machines and other basic functions such as the keyboard, display, and disk drives. On older computers, the BIOS is stored in read-only memory, which is not erased when the power to the computer is shut off. Newer computers store BIOS on flash ROM, which can be erased and rewritten if the user needs to update the BIOS program.

batch file—A text file that contains a list of instructions and is marked with the extension .BAT. When the file runs in DOS, each instruction is carried out in sequential order. A batch file can include any DOS command and can launch other programs. Batch files are useful in repetitive jobs because a user can run a series of commands or instructions by typing just one command. An example of a batch file is Autoexec.bat, which executes a series of commands when you boot your computer.

batch job—See batch program.

batch processing—The act of performing a series of calculations or jobs at a certain time, as opposed to continuous processing, in which transactions are processed as they are entered into a system. Compare to continuous processing. See batch program.



batch program—A computer task that requires no input or other type of interaction with the user. Often, batch programs involve sorting or printing items in large databases. Batch programs sometimes run as background processes at predefined times.

.BAT file—See batch file.

battery backup—A battery power supply designed to switch on automatically if the main power supply fails. Battery backups are used for critical systems where vital data or communications could be lost. See **uninterruptible power supply**.

battery pack—A rechargeable battery power supply. Battery packs usually are removable so they can be replaced with fresh battery packs when one runs down. Portable computers use a variety of battery packs made from different material combinations such as nickel-cadmium or lithium-ion.

baud—The number of voltage or frequency changes made per second on a communications line, usually a phone line. Although baud once was used interchangeably with bps, the two are different. The confusion arises from the fact that early low-speed modems transmitted information at a rate equal to the baud rate; for example, a 300 baud modem also was a 300bps modem. The two measurements diverge at higher speeds. For instance, one type of modem transmits 1200bps of information at 600 baud. The difference is in the fact that each signal change doesn't necessarily transmit one bit, so the two are not always equivalent. Compare to **bits per second (bps)**.

baud rate—see baud.

bay—A term used to describe the area toward the front of a computer typically where the disk drives and CD-ROM drives are housed. Bays usually are stacked on top of each other. The word comes from the telephone industry, where equipment was mounted on racks in similar bays.

BBS—See **bulletin board system.**

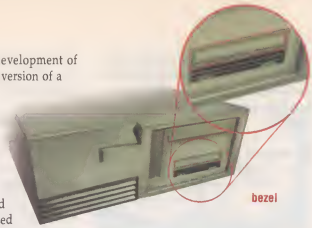
beep—The name for the sound often made by computers to indicate an error, attract attention, or prompt for input.

Bell-compatible modem—A modem able to transmit information according to the Bell standard, which set the protocol for 300 baud data transfer over phone lines. Modems manufactured today follow different, more advanced protocols that allow faster transmission. See **baud**. See **modem**.

bells and whistles—A phrase describing desirable features of a computer or application. If something has all the "bells and whistles," it must include everything and more than one expects from such a product. For example, today's major word processing programs provide more bells and whistles than most people need.

benchmark—To test aspects of computer hardware or software against a known standard. When used as a noun, a benchmark usually is the result of such a test. Benchmarks are only useful if all computers or applications being tested are tested under the same conditions. When measuring the speed of computers, for instance, a benchmark utility program should attempt to perform the same operations with each machine. It also is necessary to know exactly what a benchmark is designed to test. A machine that is speedy at one type of mathematical operation could be slow at other tasks.

beta testing—In the development of hardware and software, releasing a product to a group of testers before releasing it to the general marketplace. The process is an effort to discover flaws and correct them before the product's final release. Compare to **alpha testing**.



beta version—In the development of hardware and software, a version of a product released to a group of testers. Beta software often is available on the Internet, where users can download it at no charge. Developers want users to report any problems so they can be fixed before the product is released in the general marketplace. Beta software usually has most of the capabilities of a final release, unlike rougher alpha versions, but it usually has a set of known bugs that makes it unsuitable for a professional setting. Compare to **alpha version**. Compare to **demonstration program**.

bezel—The frame, usually made of plastic or metal, that surrounds a hard drive within a computer's case. Bezels also are used to encase cathode ray tubes (CRTs).

Bézier curve—A type of curved line defined by a mathematical formula. The curves are named after French mathematician Pierre Bézier and are used extensively by many drawing programs. Bézier curves are defined by three points, one on each end and one in the middle. Usually these points serve as handles in graphics programs that can be "gripped" by the mouse pointer to drag the curve into different shapes.

bidirectional—Able to transmit data in two directions. That does not necessarily mean, however, that data from two directions can be transmitted at the same time. A null-modem cable is one example of a bidirectional connection.

Big Blue—A nickname for IBM derived from the company's logo color.

billion—The number represented by a "1" followed by nine zeros: 1,000,000,000.

binary—The name of a number system made up of only two digits, usually 0 and 1. Any number can be represented in the binary system, although larger numbers are much longer than when expressed in the more familiar decimal system, which uses 10 digits (0 to 9).

Computers use the binary system extensively to store, receive, and transmit data. The number "1" in binary is written as 1. The number "2" is written as 10, where the one is in the "twos" position and a zero is in the "ones" position. The numbers one to 10 in binary would be: 1, 10, 11, 100, 101, 110, 111, 1000, 1001, 1010. If a set of letters is numbered, letters also can be stored in binary format.

binary conversion—The conversion of numbers and letters from the decimal or some other numbering system to the binary system used by most computers. The data represented by the numbers do not change. See **binary**.

binary digit—See **bit**.

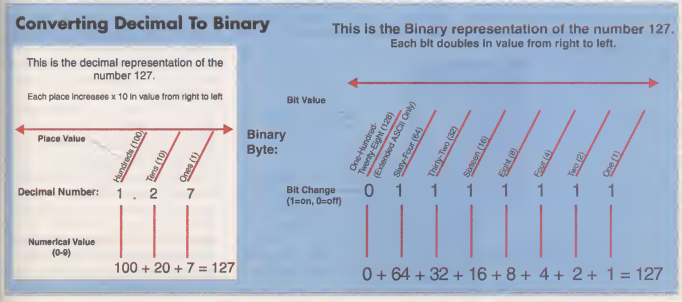
binary file—A file composed entirely of information stored in binary format. See **binary**.

binary notation—See **binary**.

binary

00100010	01010100	01101000	01010100	
00100111	01110011	00100000	01110011	
01100101	00100000	01110011	00100000	
01101100	01101100	00100000	01101100	
01100101	01110000	01100010	01110000	
01110010	00100000	01110001	00100000	
01100001	01101110	00011001	01101110	

Binary Conversion


Converting Decimal To Binary
This is the decimal representation of the number 127.
Each place increases x 10 in value from right to left
Place Value
Hundreds (100)
Tens (10)
Ones (1)
Decimal Number:
1 . 2 7
Numerical Value (0-9)
100 + 20 + 7 = 127
This is the Binary representation of the number 127.
Each bit doubles in value from right to left.
Bit Value
Binary Byte:
One-Hundred-Twenty-Eight (128) (Extended ASCII Only)
Sixty-Four (64)
Thirty-Two (32)
Sixteen (16)
Eight (8)
Four (4)
Two (2)
One (1)
Bit Change (1=on, 0=off)
0 1 1 1 1 1 1 1
0 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 127

B

binary number—A character written in binary notation of 0s and 1s.

binhex—A file compression scheme frequently used for Apple Macintosh files.

BIOS—See Basic Input/Output System (BIOS).

bipolar—Describes the main way digital information is transmitted. A digital transmission is a string of positive and negative values that can be called "1" and "0." A signal that switches back and forth between 1 and 0 is called bipolar. Bipolar also can refer to a type of computer chip design.

bis—A French word meaning "encore" or "second" that is used to denote the second release of certain standards, especially for modem data transmission. An example would be V.32bis, which is the standard for maximum speed for 14,400bps modems. See modem.

bit—Short for binary digit, the smallest unit of computer storage. A bit is a single digit in a binary number, either 1 or 0, often called "on" or "off." Physically, the bit can be represented as a transistor in a memory cell, a magnetic spot on a disk, or a pulse sent through a circuit. Alone, bits carry little information of consequence to average users. Combined in larger numbers, however, bits become bytes, also called words, and express greater amounts of information. In most computer systems, eight consecutive bits make up one byte. One byte is the equivalent to one alphanumeric character. Transmissions often are measured in bits per second, or the number of bits that pass a specific point in one second. See byte. See word.

bit depth—See color depth.

bit map—A type of graphics file in which one or more bits are used to describe the color of each tiny square that makes up the image. One kind of bit-mapped file, with the extension .BMP, is used extensively in the Windows operating environment/system. It is the default file format for the Windows Paint accessory, for example. Bit maps fall under the broad category of raster files. Compare to object-oriented graphics. See raster graphics.

bit-mapped font—A font stored as a collection of characters made up of dots. These fonts can look jagged when enlarged, as opposed to scaleable fonts, which can be blown up to any size without a reduction of quality. Compare to scalable font.

bit-mapped graphics—Graphics made up of tiny squares that are represented by one or more bits describing the square's color. Bit-mapped graphics are not suitable for scaling to larger sizes because they become jagged and blocky when enlarged. Also called raster graphics. Compare to object-oriented graphics. See raster graphics.

BITNET—Acronym for the "Because It's Time Network." BITNET was one of the first wide-area networks (WANs), founded in 1981, to serve mainly academic institutions. Computers that wanted to join the network followed specific rules to ensure transmissions could be forwarded around the system. Although it is overshadowed and being slowly replaced by the Internet, BITNET once was the largest computer network.

bits per second (bps)—A measurement of data transmission speeds. As the name implies, bps is the number of bits that pass a certain point in one second. Some of today's fastest modems transfer information over phone lines at 56,600bps, which is the same as 56.6Kbps (kilobits per second). Compare to baud.

bit stream—A transmission of data in binary, or digital, form.

bit transfer rate—The number of bits transferred in a certain amount of time. The most common unit of measurement for data transfer is bits per second.

blank character—The empty space that appears on-screen when the user presses the Spacebar.

blank diskette—A diskette that is empty and must be formatted before it can be used. To prepare a diskette to receive data, you must run the FORMAT command in your operating system.

bleed—To have text or graphics printed off the edge of a page. Bleeds often are used on purpose with graphics, but text bleeds can be a sign of a problem with a printer or the software's print setup.

blend—An area in an on-screen or printed image where one color gradually changes to a second color.

blinking—Disappearing and reappearing repeatedly. Cursors are familiar blinking objects on most computer screens.

bloatware—A slang reference to software that requires a lot of hard drive space and random-access memory (RAM) for features that may be seen to have dubious value. Bloatware is a consequence of Parkinson's law, which says resource requirements grow as the available resources grow. In other words, as soon as you add a faster processor, more RAM, and a bigger hard drive, software makers will find a way to use it all. The major Internet browsers and office suites often are tagged with this epithet. There is a reaction to this phenomenon primarily by smaller software makers, who deliberately produce applications with tightly focused functionality and moderate to low hardware requirements.

block—A group of data with a beginning and an end, usually occurring within a larger amount of data. Many users with word processors manipulate text blocks consisting of words, sentences, or paragraphs by highlighting them with the cursor and then cutting, copying, and pasting them. Spreadsheet users might highlight blocks of cells, columns, or rows to perform similar operations. Data also are saved in memory in blocks.

block cursor—A type of cursor that appears as a small rectangle, equal to the size of one character, on the display screen.

block graphics—Low-resolution graphics in which it is readily apparent the image is made up of blocks. Block graphics are a familiar feature in some DOS programs.

blue bomb—When a system crashes and leaves nothing but a blue screen. This occurs when data loss in a particular data packet, the block of data being transmitted, becomes so great that the operating system cannot process any further information. This causes the system to crash. Also known as the Blue Screen of Death and WinNuke.

.BMP—The common DOS and Windows extension for a bit-mapped file. See **bit map**.

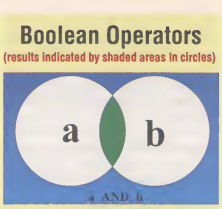
BNC connector—A type of connector used most often with coaxial Ethernet cable. The connector is bayonet-style, which means it is first inserted into a receptacle, then turned to lock tight.

boards—The thin square or rectangular platters that hold the electronic components of a computer, including microchips and the electrical conductors that connect them. Computers often contain a main circuit board (called the motherboard or mainboard) and several smaller boards (expansion boards or cards, daughterboards or cards).

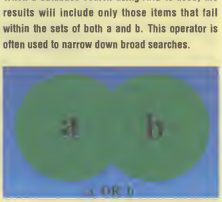
body type—The font used for the main text of a document. Often it is 10 or 12 points in size, single-spaced. Compare to **display face**.

boilerplate—User-generated text or graphics stored in computer memory that can be added to documents with just a few keystrokes. Boilerplate text is useful if certain information, such as a return address, must be reprinted often in different documents.

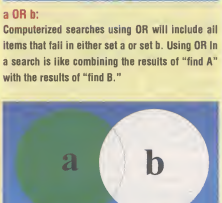
boldface—A typeface that is darker and usually a little wider than an ordinary typeface. This text is written with a normal typeface while this is written in boldface.



a AND b:
When a database search using AND is used, the results will include only those items that fall within the sets of both a and b. This operator is often used to narrow down broad searches.



a OR b:
Computerized searches using OR will include all items that fall in either set a or set b. Using OR in a search is like combining the results of "find A" with the results of "find B."



a NOT b:
Using the operator NOT in a search will exclude elements of a second set from your results. Using NOT in searches can be risky, as it may eliminate some data you actually want.

bomb—To end prematurely, hang without allowing user input, or otherwise fail. Applications are said to bomb, while entire systems usually are said to crash. However, the terms can be used interchangeably. In Windows, the CTRL-ALT-DEL key combination sometimes can regain control of or end an application that has bombed.

bookmarks—User-definable lists that allow a person to display easily a certain location within a document or a page on the World Wide Web. Mouse-clicking on a bookmark usually calls up the location it references. Bookmarks often are used in connection with Web browsing programs such as Netscape Navigator or in Windows Help screens. The lists let users point and click on names of locations instead of typing addresses or paging through screens of text.

Boolean—(Pronounced BOO-lee-un.) An adjective describing an expression that results in a value of either TRUE or FALSE. Named for mathematician George Boole, the word describes a common system of logic using mathematical expressions. It uses a defined set of operators such as AND, OR, NOR, and NOT. Any expression that contains relational operators such as the more than (>) sign are considered Boolean, because of the result being either TRUE or FALSE. Boolean expressions are used extensively in search engines on the World Wide Web. For example, if users are searching the Web for information on singer Tina Turner, they might type "Tina AND Turner" into the search box. This is a Boolean expression that will retrieve only documents containing both the words Tina and Turner. If the user does not want to read about Turner's Australian tour, the Boolean expression to be entered might be "Tina AND Turner NOT Australia." Documents that meet these criteria would be "true" and all others would be "false."

boot—To turn on a computer and cause it to start executing the basic startup software usually housed in the BIOS. Booting up a computer is the first step to using it, as the computer must load certain information in its memory before running more advanced programs. A user might reboot a computer that has crashed in an effort to regain control. The word comes from "bootstrap," the straps that help people pull on their boots. In a fancifully similar way, booting helps the computer get started. See **cold boot**. See **CTRL-ALT-DEL key combination**. See **warm boot**.

bootable diskette—A diskette that contains the necessary part of the operating system so the computer can boot up. Most

B

computers with hard drives boot from that, but older computers might boot from diskettes in the A: or B: drive. It is a good idea to keep a bootable diskette handy in case something goes wrong with the hard drive, as most computers first check the diskette drives for bootable disks before checking the hard drive. A faulty hard drive can be bypassed this way.

bootleg—An illegally reproduced copy of a piece of software. Many manufacturers attempt to foil bootleggers by incorporating anti-copy measures into their products, but nearly every useful program is copied by someone eventually. Software developers consider bootleg copies produced in large quantities by rogue manufacturers in other countries a significant problem.

boot sector—A section of the startup disk, usually the hard drive, reserved for the part of the operating system that must be loaded first during bootup. The boot sector usually is on the first sector of the first partition of the drive.

boot sector virus—A virus that corrupts or replaces the master boot record (MBR). Because the MBR is needed to boot the computer, such viruses can cripple a computer by making it impossible to boot from the hard drive. These viruses usually are spread by diskette. Making sure there is no diskette in the drive upon boot up is a good way to avoid catching this type of virus. Once a computer is infected, you'll need to boot from a diskette and run an antivirus program to remove the virus. If you accidentally boot from a diskette, turn off the computer when you get the "Invalid system disk" message, remove the disk and restart. As long as the computer doesn't boot up, there's a chance the virus may not have been passed to the hard drive. See **bootable disk**. See **master boot record**.

border—In desktop publishing, a line or other graphical element that surrounds an area like a picture frame.

bounced E-mail—E-mail that could not be delivered to the intended recipient and is returned to the sender. The most common causes of bounced E-mail messages are misspelled or improper addresses or the recipient exceeding the mail capacity established by the Internet service provider (ISP). E-mail messages also may bounce because of network errors or configuration errors. Bounced E-mail messages almost always include a lengthy description of what went wrong when your ISP tried to deliver the message. Look for misspellings if you see errors such as "User not found" or "Host not found." If the address is spelled correctly, the problem probably is related to a network malfunction or mail capacity being exceeded. The best recourse is to wait a few hours for those problems to clear up and then resend the message.

BREAK key

BREAK key—A special key on some keyboards that interrupts a process in progress. BREAK keys often are used when a program hangs or bombs. Not all applications today respond to the BREAK key. In Windows and DOS environments, the equivalent is the CTRL-ALT-DEL key combination.

bridge—A network or telecommunications device that connects one local-area network (LAN) to another using a common protocol. Local bridges generally connect networks contained in a single building or campus. Remote link bridges employ telecommunications links with modems or leased lines to connect networks separated by longer distances. Compare to **router**. Compare to **brouter**.

brightness—A display control that manipulates the level of light emitted, usually by a monitor screen. If your display is blank, you might need to adjust this control. The knob can be on the front, back, or sides of the monitor. Compare to **contrast**.

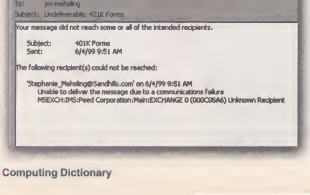
broadband network—A network in which data move at high speeds. See **broadband transmission**.

broadband transmission—Communication in which the wire or line can transmit several data streams simultaneously. One example is the coaxial cable used in cable television systems, which carries multiple

bps—See **bits per second**.

break—A signal used to stop a program or transmission. In a program, a break occurs when the "Break" key or its equivalent (often CTRL-ALT-DELETE, CTRL-C, or ESC) is pressed. In data communication devices such as modems, a break occurs when a modem or computer sends a break command or disconnects. In the context of word processing, it also can mean the end of a section (section break) or a page (page break). See **BREAK key**.

bounced E-mail


Undeliverable: 401K Forms - Repeat
File Edit View Insert Tools Actions Help
Send Again...
From: System Administrator
To: jim-mehaling
Subject: Undeliverable: 401K Forms
Your message did not reach some or all of the intended recipients.
Subject: 401K Forms
Sent: 6/4/99 9:51 AM
The following recipient(s) could not be reached:
'Stephanie_Mehaling@Sandhills.com' on 6/4/99 9:51 AM
Unable to deliver the message due to a communications failure
MSEXCH:IMS:Pared Corporation:Main:EXCHANGE 0 (000C05A6) Unknown Recipient

box—A graphical area that appears on-screen, usually with information or a request for user input, in a graphical user interface (GUI). Boxes are different from windows in that they usually cannot be resized or otherwise manipulated. Boxes are part of an application, whereas windows usually contain an entire application. In some instances, a box might also be a synonym for "computer," for example, a Macintosh box.

channels at once. More recently, broadband has come to describe high-speed data transmission, especially over the future Internet, sufficient to carry live video on demand. Compare to baseband transmission.

broadcast—To transmit information to more than one person simultaneously. Television and radio are classic examples of broadcasting, but computers also allow users to broadcast text. E-mail messages and faxes are examples.

brouter—A network device that combines bridging and routing functions. This is an efficient combination because it means data packets carried over a network will have one less stop on their journey across the network. In networks with separate routers and bridges, all packets go through a router that determines the shortest route to the packet's destination. If that destination is outside of the local-area network (LAN), it also will have to go through a bridge. Brouters, on the other hand, combine these functions. See **bridge**. See **packet**. See **router**.

brownout—A temporary, partial loss of power, ordinarily because of a dip in the power supply level. This is different from a blackout, which is a temporary but complete loss of power.

browse—To view data, usually in such a way that you can page through screens or windows quickly. Today the verb is associated with looking at sites on the World Wide Web.

browser—An application that allows users to download World Wide Web pages and view them on their own computers. Graphical browsers can display pictures and text and allow you to navigate from one page to the next with a mouse. Two of the most popular browsers are Netscape Navigator and Microsoft Internet Explorer. The first graphical Web browser was called Mosaic; it is credited with launching the Web frenzy. Graphical browsers make the Web more attractive and easier to use. The key aspect of browsers is that they can all display the Hypertext Markup Language (HTML) code in which Web pages are commonly written. A Web page should look largely the same regardless of the browser in which it is displayed. See **download**. See **Hypertext Markup Language**. See **Web page**. See **Web site**. See **World Wide Web**.

brush—A basic tool in many drawing and painting applications. Depending upon the program, the brush might create areas of different colors in drawings or be configured to perform more complicated functions.

brute force—A programming style that relies on computer power rather than the skill of the programmer to solve a problem. This is considered a primitive way of programming, and brute force usually only works well in simple programs because the programs use extremely simple methods to solve the problems presented to them. If the problem is complex, however, such programs become inefficient because they try all the possibilities to find the answer, which takes an inordinate amount of time and computing power. The common illustration of brute force programming involves the "traveling salesperson problem." Suppose a salesperson has 15 cities across the country he wants to visit in an order that would minimize travel. The brute force method is to calculate the mileage of every possible scenario. This method is guaranteed to work but is inefficient because it considers illogical route combinations (for example, Boston-Seattle-New York-San Francisco). Even with just 15 cities, there are more than a trillion possible routes to consider under this method. See **algorithm**.

Bubble Jet printer—The name used for Canon Computer Systems' inkjet printers. See **inkjet printer**.

bubble memory—A magnetic data storage device that is slower than a hard drive but can withstand greater stress. Bits are stored as tiny electromagnetically produced "bubbles" in the thin magnetic layer. The bits are rotated past a read/write head to access the information.

buffer—A temporary storage area in a computer's memory, usually RAM, that holds recent changes to files and other information to be written later to the hard drive. Because hard drives are relatively slow compared to RAM, buffers speed up performance. However, buffers generally are wiped clean by power outages; saving a file moves the information to the hard drive. Print buffers allow printing in the background while the user moves to another application or document. Buffers also are used by some transmission protocols. Incoming data might be stored in a buffer until they are verified.

buffering—Saving information to a device's buffer, then passing it on. See **buffer**.

bug—A flaw in an application or piece of hardware that causes a persistent malfunction or undesired result. Software bugs can be corrected by rewriting the software code. Hardware bugs are corrected by redesigning the hardware. The first computer bug is said to be a moth found in ENIAC, one of the first digital computers, in 1945. The moth caused a malfunction after being crushed between two electrical contacts. The term itself is older, however, and some sources trace it back to the 1800s.

built-in font—See **internal font**.

bulk eraser—A device that uses electromagnetic energy to erase data from a magnetic storage medium such as diskettes or hard disks.

bulk storage—A medium used to store large amounts of information. Two examples of bulk storage are magnetic tapes and large hard drives.

Bubble Jet printer

bullet—A small graphical element used to set off items in a list. Classic bullets are small filled-in circles (•), but bullets also can be squares or other shapes. Bullets often are used in word processing and desktop publishing applications.

bulletin board system (BBS)—An online computer system you can access through your modem that acts as a central source of information. Like the BBS's physical counterpart found in supermarkets and community centers, users can read or post messages, but with BBSes they also can trade software. Bulletin board systems usually are geared toward particular interests and can come in all sizes.

bundled software—Software included, often at no charge, with another application or piece of hardware. For instance, many new computers are sold with preloaded operating systems and other applications. Modems are frequently sold bundled with communications software. Increasingly, free programs, such as World Wide Web browsers, are bundled with other programs purchased at software stores. Bundled software can add considerable value to a product, but some common bundled software, such as online service startup diskettes, are always free.

burn in—A condition in which a bright unchanging light on some types of computer displays can, over time, permanently burn an image into the phosphor coating inside the display tube. Burn in can be prevented by turning off an unused monitor or using a screen saver, which continually changes the image to prevent one picture from appearing on-screen for too long. Burn in is not much of a problem with newer computer monitors.

burst—A block of data transmitted at once.

burst mode—When data are transmitted all at once rather than sequentially. Burst transmissions generally are not maintained for long, hence the name. Usually they require one computer taking control of an entire data bus for a short time.

bus—The electric connection linking electronic devices such as the internal sections of a computer (e.g., the CPU, expansion cards, and peripherals). The amount of data that can be simultaneously transported along a bus is determined by the number of connections for moving binary numbers. For instance, a 16-bit bus can transport up to 16 ones and zeros (binary digits) at once. Popular types of buses include Peripheral Component Interconnect (PCI) and Small Computer System Interface (SCSI). In networks, a bus is the cable system known as the backbone, which connects all computers into a single network. See **bus width**. See **Peripheral Component Interconnect**. See **Small Computer System Interface**.

bus extender—An electronic device that allows larger expansion boards to be used with smaller expansion slots. For example, bus extenders for the eight-bit IBM PC/AT use 16-bit expansion cards.

bus mouse—A mouse that connects to a computer's main bus line through an expansion card. See **bus**.

bus network—See **bus topology**.

bus system—The part of a computer that controls the bus and connects it to other components.

bus topology—A type of computer network in which all of the workstations or nodes are connected to one main line. The advantage is that one malfunctioning node does not hamper the rest of the network. Also called bus network. Compare to **ring topology**. Compare to **star topology**.

bus width—The amount of data a bus can handle at a time. Many buses are either 16-bit or 32-bit, meaning they can transmit 16 or 32 bits simultaneously. The more bits a bus can handle, the more data can be transmitted at one time, allowing the computer to perform tasks more quickly.

button—An area on a computer screen in a graphical user interface (GUI) that performs some function when selected by the mouse or, in some cases, by pressing the ENTER or RETURN key. On-screen buttons look something like their real-world namesakes. Usually they include labels or some graphical element to denote their function.

byte—A byte is equal to either seven or eight bits, depending upon whether it requires an extra bit used for error correction, called a parity bit. A byte is sufficient for storing a single character of information, such as the letter A or the number 2, when encoded in a format such as ASCII. See **American Standard Code for Information Interchange**. See **parity bit**.

C—A high-level programming language developed in the 1970s. C is a compiled language containing only a small number of built-in, machine-dependent functions. The majority of functions are machine-independent, which means they are not linked to a particular computer. Machine-independent functions can be used on different computers with little or no change.

C:—When followed by a colon, C refers to the C: drive, usually the hard drive inside a computer. However, this designation can be changed by the user.

C++—An object-oriented version of C, developed in the early 1980s. This version has all the capabilities of C, as well as object-oriented programming capabilities. This language is popular for programming graphical applications. See **object-oriented programming**. See **object-oriented programming language**.

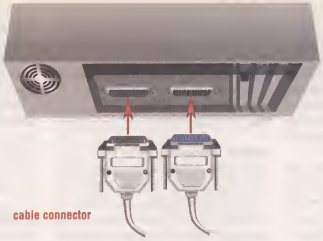
cable—A bundle of wires in a protective rubber or plastic covering, with connectors on both ends, used to link various parts of the computer system to the computer. A variety of types and sizes of computer cables are available; many devices require a specific kind of cable. See **coaxial cable**. See **fiber optic**. See **twisted-pair cable**.

cable connector—The plug at either cable end. One end plugs into the computer, and the other plugs into the device being hooked up to the computer. Connectors are either male (containing pins) or female (containing sockets). The type of cable often determines the shape of the connectors. For example, most cable connectors for mice or

keyboards are round, while printer cables have trapezoidal connectors.

cable matcher—A device that lets a cable be attached to a device that requires slightly different wire connections.

cable modem—A modem that uses your cable TV connection instead of a phone line to connect to the Internet. Because the bandwidth of coaxial cable is much higher than that of the standard phone line your telephone company uses, the speed advantage of cable modems versus regular phone modems is profound. Cable modem speeds range from 500Kbps to 10Mbps. The top speed of phone modems, by comparison, is almost 30 times slower, at 53Kbps. Cable modems' highest speeds are for downloading; you won't be able to send data nearly as fast because cable TV networks are designed primarily to send information out to homes. Overall speed also varies widely because bandwidth on a cable TV network is a shared resource. If everyone on your block signs up for cable modem service and downloads large files, the available bandwidth—and speed—will drop dramatically. Most cable modems are currently external models that connect to a computer via an Ethernet port. Compare to **Asymmetric Digital Subscriber Line (ADSL)**.



cabling diagram—A map of the cables that connect components to a computer system. The map shows how each component is connected to the computer.

cache—(Pronounced CASH.) A bank of high-speed memory set aside for frequently accessed data. The term "caching" is used to describe placing data in the cache. Memory caching and disk caching are the two common methods used by PCs. Whenever data are accessed from or committed to main memory, a copy, along with the address, is saved in the cache along with the associated main memory address. A memory cache maintains a list of frequently accessed data, complete with the address of that data. When the processor attempts to access an address, the cache checks its stores. If the memory cache holds the requested address (called a cache hit), it returns the data to the processor. If not (called a cache miss), a traditional memory access takes place. Disk caching works essentially the same way but uses conventional main memory instead of high-speed memory. Many microprocessors today have built-in memory caches, which are called primary or Level 1 (L1) caches. External cache memory also can be added, called secondary or Level 2 (L2) caches. See **disk cache**. See **Level 1 caching (L1)**. See **secondary cache**.

cache card—A board inside the computer that provides quick storage. Some computers have built-in cache cards; others have slots where a cache card can be installed.

cache hit—A request for data found in cache memory.

cache line—The smallest amount of memory that can be used in a cache.

cache line fill—To load a cache line from main memory into the cache.

cache memory—See **cache**.

cache miss—A request for data not found in cache memory. When this occurs, the computer must search the main memory to find the data.

CAD—See **computer-aided design**.

CAD/CAM—See **computer-aided design/computer-aided manufacturing**.

CADD—See **computer-aided design and drafting**.

CAE—See **computer-aided engineering**.

CAI—See **computer-aided instruction**.

CAL—Computer-assisted learning. See **computer-aided engineering**.

C

calculator—A device that performs arithmetic operations. Some calculators can be programmed for advanced functions, and some can store numbers in memory. Some computer applications and operating systems include built-in calculators. Many of these display a representation of a calculator on-screen, letting the user either type in the numbers or use a mouse to click the numbers as with a handheld calculator.

calendar program—An application that replaces a traditional calendar with a computerized representation. Some look like wall calendars while others are more like appointment books, with single days or weeks divided into hours or half hours; many can switch between different formats. Calendar programs often include "to-do" lists, phone books, and alarms that can be set for important items. Other calendars serve different functions, such as calculating the dates over several hundred years so users could find out what day of the week a certain date occurs.

calibrate—The process of testing, tweaking, and resetting a measuring or timing factor against a set standard to ensure a device, such as a scanner, is working properly.

callback modem—Instead of answering incoming calls, this type of modem directs callers to input a security code and hang up. The callback modem then checks the code against a set of authorized numbers. If the code matches, the modem calls the person back and opens a connection for that caller. These modems are used when data must be kept secure, but outside users need access to communications lines.

call up—To open a program, file, or document. This makes it appear on-screen and ready for using or editing.

callback modem—Instead of answering incoming calls, this type of modem directs callers to input a security code and hang up. The callback modem then checks the code against a set of authorized numbers. If the code matches, the modem calls the person back and opens a connection for that caller. These modems are used when data must be kept secure, but outside users need access to communications lines.

CAM—See computer-aided manufacturing (CAM).

camera-ready—Ready to be sent to a printing service. The printing service takes a photograph of the document and creates a printing plate. The plate is then incorporated into the press, and the print job begins.

Cancel—A button in almost any dialog box in a graphical user interface (GUI) that lets a user exit the dialog box without making any specified changes. It returns any settings to their status before the box was opened.

canned software—Off-the-shelf software available in stores, as opposed to custom software created for a specific company or individual.

capacity—In terms of storage, a computer has reached its capacity when it can no longer store more data. In terms of processing, capacity means a computer cannot process more information. See **channel capacity**. See **disk capacity**. See **memory capacity**. See **processing capacity**. See **register capacity**.

capital letters—Uppercase letters, such as A, B, C, and so forth, as opposed to the lowercase a, b, and c. Also called capitals or caps. See **case**.

capitals—See **capital letters**.

caps—See **capital letters**.

CAPS LOCK key—A key that, when pressed, makes all typed letters appear in uppercase, until the key is pressed again. CAPS LOCK affects only letters, not numbers, symbols, or punctuation marks.

capture—To move received data into a file for storage or later use. Sometimes this refers specifically to saving all the information that appears on your screen during a communications session so there is a record of the online "conversation." The term also can refer to a screen capture (also called a screen dump), in which the image on the monitor is captured as a graphics file.

carbon ribbon—A type of ribbon used with impact printers and typewriters. The ribbon is made of a thin strip of Mylar and coated on one side with a carbon film. Also called film ribbon or Mylar ribbon. Carbon ribbons produce clearer printing than inked cloth ribbons, which also are used in impact printers and typewriters.

card—A printed circuit board or adapter that plugs into a computer to add a new function such as modem capabilities or hardware device support. The term also refers to the punched cards used for data storage and entry devices in early computing. See **punched card**.

card cage—The area in the computer where cards are installed. The area usually has protective metal and mounting brackets. The term comes from an external, cage-like box where cards were on older computers.

card punch—A machine that put holes in punched cards used in early computers. See **punched card**.

card reader—See **magnetic card reader**. See **punched card reader**.

cardinal number—A counting number such as 1, 2, 3, and so on. Cardinal numbers tell how many items there are in a group, as opposed to an ordinal number that tells a position such as first or fifth.

caret (^)—The symbol usually found on the number 6 key at the top of the main part of a computer keyboard. Some programming languages use the caret as an exponential operator. For example, the phrase 4^2 means the number four to the second power, or four squared. In computer instructions, the caret often is used to represent the CTRL key on the keyboard.

carpal tunnel syndrome—A repetitive strain injury or cumulative trauma disorder affecting the wrists. Carpal tunnel syndrome can be caused by excessive time spent typing or by having the hands in an ergonomically incorrect position while typing.

carriage—The part of a typewriter or typewriter-style printer that holds the platen, which is the roller around which the paper is wrapped and against which the print mechanism strikes.

carriage return (CR)—The control character that instructs a printer or computer to go back to the beginning of the current line of text. Unlike the RETURN or ENTER key, it does not advance automatically to the next line. To advance to the beginning of the following line, the carriage return is combined with the linefeed character; this combination is called carriage-return/linefeed (cr/lf).

carriage return/line feed (cr/lf)—The combination of two control characters (carriage return and line feed) that cause the printer or computer to advance to the beginning of the next line.

carrier—A company that provides communications services, such as a telephone company. The term also refers to a radio frequency signal that vibrates at a fixed number of cycles per second, or hertz. Either the frequency or the amplitude of the signal is modulated to let it carry information. These signals are used with modems and networks to transmit information from one computer to another. Also called carrier frequency, carrier signal, or carrier tone. See **amplitude**. See **frequency**.

carrier detect (CD)—A signal sent to a computer by an attached modem indicating the modem is ready to dial.

carrier frequency—See **carrier**.

carrier sense multiple access/collision avoidance (CSMA/CA)—In network systems, a method of avoiding conflicts between messages sent on the network. When a node on a network with CSMA/CA is about to send a message, it sends a jam signal, waits a moment, and then starts to transmit the message. If during the transmission of a message the network detects

another node's jam signal, indicating that a second message is about to be sent, the second transmission is stopped, and the second node waits a random length of time before trying again.

carrier sense multiple access/collision detection (CSMA/CD)—In networks using a bus topology, a protocol to avoid conflicts between messages sent on the network. It works similar to old telephone party lines, in which households shared telephone lines. When callers wanted to use the line, they would pick up a receiver to hear if someone else was using it. If not, they could place a call; otherwise, they had to wait or try again later. CSMA/CD works along the same principles: A transmitting computer must monitor whether the "line" is being used before it can transmit its request to the server. When more than one node tries to use the network at one time, all nodes stop, wait a random length of time, and try accessing the network again. Compare to **token passing**. See **bus topology**.

carrier signal—See carrier.

carrier tone—See carrier.

carry—In mathematical addition, to move a digit to the next higher position when the sum of the numbers added is more than the largest number. For example, if you add eight to four, the one representing 10 in the result (12) is carried to the tens column. Carries were a challenge for early inventors of adding machines, and computers today have several complex ways of carrying.

carry bit—The bit that indicates to the computer that an addition function has resulted in a carry, as with 8 + 4 = 12.

carry flag—See carry bit.

cart—See cartridge.

Cartesian coordinates—Named for French philosopher and mathematician René Descartes, Cartesian coordinates define the positions of points on a two-dimensional plane in relation to their location on intersecting axes. Coordinates are expressed in the form (x, y), in which the x defines a horizontal measurement, and the y defines a vertical measurement. Cartesian coordinates also can refer to points in three-dimensional space; in this case, a third axis, called z, is added to the other axes.

cartridge—A self-contained device, usually in a protective plastic shell. There are several kinds, including ink cartridges, disk cartridges, memory cartridges, and toner cartridges. Also called cart.

cartridge font—A font that is contained in a plug-in cartridge so it can be added to an older-model laser, inkjet, or high-end dot matrix printer, giving it the ability to print in fonts not originally included with software. Compare to **internal font**.

cartridge hard drive—See **removable hard drive**.

CAS—See **column address strobe**.

cascade—An option that organizes the open windows on a computer screen so they are stacked in an overlapping pattern, with the active window on top. Only the title bars of those windows not on top show. Clicking any of the title bars will bring that window to the top.

cascading menu—A secondary menu that appears next to the original menu when an option with a menu of its own is selected. This arrangement is common when a menu item has many related commands. Some cascading menu items have their own cascading menus in turn. This multilayer menu system is where the term cascading came from, as each menu flows from the one before it.

cascading style sheets (CSS)—Style sheets that can be applied to multiple Web pages instead of one. Instead of defining the style sheet in the <HEAD> section of an HTML file, the style sheet is stored in a separate CSS file. The location of the CSS file is then specified in the <HEAD> section in place of the style sheet. The benefit of using cascading style sheets is that style changes can be made to every page in a Web site using the style sheet at once, instead of having to replace the style sheet in each individual page. New pages can also be quickly and easily created without having to retype or reenter the style sheet. Cascading style sheets are fully supported in version 4 or higher of both Navigator and Internet Explorer. See **style sheet**. See **Hypertext Markup Language**.

cascading windows—See cascade.

case—The housing for the computer. Also refers to the format of a letter, as in whether a letter is uppercase (capitalized) or lowercase (not capitalized). Uppercase letters are A, B, C, and so on; lowercase letters are a, b, c, and so on. The term comes from the early days of printing, when individual letters were stored in trays or cases, with the capital letters in the "upper case," and the non-capitalized letters in the "lower case."

CASE—See **computer-aided software engineering (CASE)**.

case insensitive—Disregarding capitalization. A program that is case insensitive would, for example, consider the words "Apple" and "apple" the same. Compare to **case sensitive**.

case sensitive—Considers capitalization. A program that is case sensitive would consider "Apple" and "apple" two separate words. It's important to know whether a program is case sensitive, especially for using passwords, search and replaces, and sorts. For example, if you ask a case-sensitive program to replace all instances of the word "apple" with the word "pear," any instances of "Apple" (with the capitalized A) will not be changed. Similarly, a case-sensitive program will sort a list of words with the capitalized words first, so that

"Apple" would come before "advertisement." Compare to **case insensitive**.

case statement—A control statement found in many high-level programming languages that is used in assessing situations that have many possible results. Often, a case statement is a series of IF-THEN statements, in which the computer matches the condition to the situation and then performs the appropriate task. For example, if the situation meets condition *A* then the computer would perform task *A*. If the situation matches condition *B*, the computer performs task *B*. Also called a switch statement or multiway branch.

cassette tape—A plastic cassette containing tape on which data can be recorded. Sometimes cassette tapes are used to back up computer data. See **tape**.

CAT—See **computer-aided testing (CAT)**. See **computer-assisted**.

catalog—A list of information about files or storage space. File details might include name, length, type, and location. In a database, catalog refers to the data dictionary.

cathode-ray oscilloscope—A tool that tests and measures electric signals and creates visual displays. Most oscilloscopes display the voltage of a signal over time. An electron beam from circuits inside the oscilloscope sweeps across a cathode-ray tube's display screen and measures the voltage of the signal.

cathode-ray tube (CRT)—The display screen used in most televisions and standard computer monitors. An electron beam moves across the back of the screen, lighting up phosphor dots inside the glass tube, which causes an image to be displayed.

CAV—See **constant angular velocity (CAV)**.

CBL—Acronym for computer-based learning. See **computer-aided instruction (CAI)**.

CBT—See **computer-based training (CBT)**.

CC—See **cursor control (CC)**.

CCD—See **charge-coupled device (CCD)**.

CCD Raw mode—A setting on digital cameras that takes photos at the highest possible resolution. On most digital cameras, the Fine and Normal setting still use a compression format, such as Joint Photographic Experts Group, to store photos. CCD Raw, on the other hand, does not compress the image, storing it at the truest possible resolution. This will, of course, require more storage space, so you won't be able to fit as many CCD Raw photos onto a storage card as photos taken at the Normal or Fine settings. See **charge-coupled device**.

CCITT—See **Consultative Committee for International Telephony and Telegraphy (CCITT)**.

CCITT Groups 1-4—Standards for the transmission of a facsimile (fax) set down by the Consultative Committee for International Telephony and Telegraphy (CCITT). Groups 3 and 4 are the only standards still in use. Group 3, which was adopted in 1983, is the set of standards to which most fax machines conform. The Group 4 protocol requires Integrated Services Digital Network (ISDN) lines.

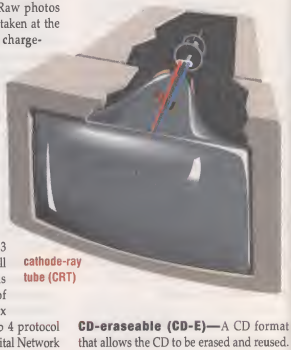
CCITT V series—Several international modem standards set by the Consultative Committee for International Telephony and Telegraphy (CCITT). The standards help buyers ensure modems they buy will communicate with other modems. The standards, formerly used primarily outside the United States, have been accepted almost universally since the advent of the 2400bps modem. Not all are relevant to computer users. See **V.21**. See **V.22**. See **V.22bis**. See **V.23**. See **V.26**. See **V.26bis**. See **V.27**. See **V.27bis**. See **V.27ter**. See **V.29**. See **V.32**. See **V.32bis**. See **V.34**. See **V.42**. See **V.42bis**.

CCITT X series—The series of standards recommended by the Consultative Committee for International Telephony and Telegraphy (CCITT) for private and public computer network equipment and protocols. A few of the most important standards are listed: See **X.25**. See **X.400**. See **X.500**.

CD—See **carrier detect (CD)**. See **compact disc (CD)**.

CD player—A machine that plays audio CDs. Although CD-ROM players can play audio CDs, regular CD players cannot play the CD-ROMs meant for computers.

CD-E—See **CD-eraseable (CD-E)**.



cathode-ray tube (CRT)

CD-eraseable (CD-E)—A CD format that allows the CD to be erased and reused. CD-Es are said to have 10-year lifespans and can be overwritten 10,000 times. CD-E drives can play and write to discs and retrieve information from CD-ROMs. The technology was unveiled in 1995 after collaboration among 10 companies (including IBM, Philips, Sony, and Hewlett-Packard), and drives were made available in the spring of 1997. Also called CD-rewriteable. See **phase change**.

CD-I—See **CD-interactive (CD-i)**.

CD-interactive (CD-i)—A standard for entertainment systems that are aimed at the mass market to play interactive, real-time multimedia. CD-i systems, which combine the best of computer data with entertainment/multimedia that may be seen on television, are standalone players that connect to TV sets. The CD-i systems play CD-i discs that store data digitally for games, educational material, and business. CD-i was developed by Philips and Sony. Included in this standard is the CD Real

Time Operating System (CD-RTOS), which is included in the CD-i player. The operating system synchronizes audio, video, text, graphics, and computer data.

CD-R drive—See CD-recordable drive (CD-R drive).

CD-recordable drive (CD-R drive)—A drive that can read and write to CDs, letting users create their own CD-ROMs. Unlike the CD-eraseable format, these discs, once recorded, can't be erased and reused, although the information can be stored in numerous sessions (if the disc is not filled in the first session). CD-R drives can play CD-ROMs and CD-R discs, and CD-R discs can be played in (but not written to) CD-ROM drives. CD-R discs have a blue-green tinge because the material on the discs is a dye polymer. When information is recorded, a laser in the CD-R drive heats up the dye material, altering the reflection of the returned light. The different colors of returned light is how the drive reads the 0s and 1s, or ons and offs, of digital data. This is why recording a CD-R disc is called burning a CD.

CD-rewriteable—See CD-eraseable (CD-E).

CD-ROM—See compact disc, read-only memory (CD-ROM).

CD-ROM drive—An internal or external disk storage device that reads CD-ROMs. CD-ROMs look much like the compact discs we use to play music, but CD-ROMs are used to store huge amounts of information, up to 660MB of text, graphics, hi-fi stereo, and full-motion video. Phone directories, encyclopedias, and novels are all stored on CD-ROMs. A major advantage of a CD-ROM drive is its speed at retrieving data. CD-ROM drives are available in two (2X or double or dual), four (4X or quad), six (6X), eight (8X), 10 (10X), 12 (12X), 16 (16X), 24 (24X), 32 (32X), and faster speeds. The higher the number, the faster the seek time and data transfer rate.

CD-ROM extended architecture (CD-ROM XA)—An extension of the CD-ROM format, introduced in 1991 by Sony, Philips, and Microsoft. This format allows for interleaved compressed audio and data sectors on a track, making it possible for text and video to be narrated in CD-ROM software. Additional hardware is required to separate the interwoven audio and data when the disc is played. The hardware separates the audio and decompresses it to play through audio jacks, while passing the data to the computer. This can be done with a regular CD-ROM player but requires a CD-ROM XA controller card in the computer.

CD-ROM extensions—The device drivers added to MS-DOS to allow the CD-ROM to function as a disk drive. These extensions allow the computer to access information stored on a CD-ROM.

CD-ROM player—See CD-ROM drive.

CD-ROM XA—See CD-ROM extended architecture (CD-ROM XA).

CD-RW—See CD-rewriteable.

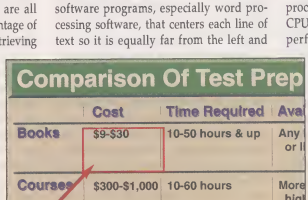
CDF—See Common Data Format (CDF). See Channel Definition Format (CDF).

cell—The intersection of a row and a column in a spreadsheet, such as cell A1, the cell at the intersection of column A and row 1. Each cell is a box that can hold text, a numerical value, or a formula.

center—To place text or graphics in the center of a page or other defined space. Usually, this means to place it at equal distances from the margins.

center justification—A setting in some software programs, especially word processing software, that centers each line of text so it is equally far from the left and right margins. This kind of justification often is used for headlines and for text on such items as wedding invitations. Many word processors have a button that lets users center text with a single mouse click.

central processing unit (CPU)—The computer's control unit or microprocessor; its "brain." The CPU, a silicon chip often enclosed in a plastic casing, interprets and carries out instructions. The first generation of CPUs was the 8080 microprocessor from Intel, introduced in 1974. It had an eight-bit data bus, which meant it could transfer eight bits of data to and from the CPU, and it used eight bits to address memory locations. In 1978, Intel introduced the 8086 and 8088, with 16-bit registers, which allowed the chips to process 16 bits of information at a time. The chips also had 20-bit memory addressing. The 8088 had an eight-bit bus while the 8086 had a 16-bit bus. Next came the 80286, called the 286, in 1982. It had a 16-bit data bus, 16-bit registers, and 24-bit memory addressing. The 386 generation was the first to have two types, the 386SX and the 386DX. The 386DX came first and was a full 32-bit microprocessor. That means it had 32-bit registers, a 32-bit data bus, and 32-bit memory addressing. The 386SX, a less expensive version introduced in 1988, had only a 16-bit data bus. The 486DX, introduced in 1989, was still a 32-bit processor but had enhancements that resulted in better performance. The 486SX also was a full 32-bit processor but lacked the math coprocessor present in the 486DX. The 486DX2, introduced in 1992, used clock-doubling to double the speed of all the microprocessor's internal operations. The Pentium, introduced in 1993, has a 32-bit address bus but a 64-bit data bus. Pentium III and Pentium II processors are Intel's newest advances. A CPU's clock speed determines how fast it performs calculations; the 80286, for instance, could run at up to 12MHz while a new Pentium chip might run at up to 550MHz. Although most IBM-compatible PCs use Intel CPUs, other companies such as Cyrix and AMD also produce compatible microprocessors able to run nearly all of the same software. Intel's position as the dominant CPU manufacturer has allowed it to determine, to a large extent, the direction of the computer industry.



centralized data processing—The centralized location where all of a company's computer processing facilities exist and all computer tasks and operations take place. In this organizational structure, employees access the company computer system through a network of dumb terminals. See **dumb terminal**.

centralized processing—See centralized **data processing**.

Centrex—A type of phone line that offers switching at the central exchange instead of at a private bank exchange (PBX). PBX systems often are used in businesses to handle large numbers of phone extensions. Centrex lines give large companies flexibility in terms of handling large numbers of phones, but without having to maintain a separate, expensive PBX. Centrex lines are cost-efficient for connecting Internet service providers (ISPs) to customers using Integrated Services Digital Networks (ISDN). See **Integrated Services Digital Network (ISDN)**.

Centronics interface—See **Centronics parallel interface**.

Centronics parallel interface—Has eight parallel data lines and lines for control and status information exchange between the PC and items such as a printer or scanner. It was named for Centronics Inc., the printer company that originally developed the standard. (The interface for modern PCs was designed by Epson but still is referred to as a Centronics interface.)

CERN—Short for the European Laboratory for Particle Physics (Conseil Europeen pour la Recherche Nucleaire), the birthplace of the World Wide Web. At the laboratory, Engineer Tim Berners-Lee invented Hypertext Markup Language (HTML) while searching for a method to share information among researchers at CERN and around the world. The system developed at CERN laid the groundwork for today's World Wide Web by developing standards and protocols for Web servers and browsers, namely the HTML used to compose Web pages. See **Hypertext Markup Language (HTML)**.

CGA—See color/graphics adapter (CGA).

CGI—See common gateway interface (CGI) **scripting**. See **computer graphics interface (CGI)**.

CGI scripting—See common gateway **interface (CGI) scripting**.

CGM—See **computer graphics metafile (CGM)**.

chad—The material cut out when a hole is punched in a card, tape, or paper.

chain printer—A line printer that has a print mechanism consisting of a chain of characters that spins around a set of print hammers. The hammers strike the characters to produce impressions on the paper.

chained list—A series of items, each of which contains the location of either the previous or the following item.

chaining—Linking two or more things together so that they depend upon each other; one program causes another to execute. Within a program, statements are considered chained if all but the first statement depends upon the previous statement. Segments of data storage are considered chained if, for example, a single file occupies several sectors, each of which points to the next section of the file and its location in memory.

change file—A transaction file in which changes to a database are logged. The change file is then used to update a master file. Also called a transaction log.

channel—The path through which information flows from one device to another. This link can be either internal or external to the computer. Internally, a channel is more commonly called a bus. It is the physical link that facilitates the electronic transfer of digital information. A channel transfers information, for example, from the CPU to the keyboard. Externally, and typically in communications, it is a line or circuit that carries either analog or digital information, depending on the type of channel. Channel also can refer to an individual chat group using the Internet Relay Chat system. See **bus**. See **Internet Relay Chat (IRC)**.

channel adapter—A device that allows communication among pieces of hardware with different types of channels.

channel capacity—The fastest speed at which a communications channel can transfer data, measured in baud or bits per second (bps).

Channel Definition Format (CDF)—A specification used to "push" content from Internet channels. Two of the most popular programs supporting CDF are PointCast, which delivers news stories to a computer's desktop, and Microsoft Internet Explorer. See **push**.

channel latency—The time it takes for a channel to reload and become ready for data transmission. See **latency**.

character—One byte of information that represents a single symbol. In word processing programs, a letter can represent a character. However, not all characters are visible. For example, the space between two letters can be a character. Some programs let you make these characters visible. For example, Microsoft Word has a mode in which spaces and paragraph marks are displayed on-screen but do not appear when the document is printed.

character cell—The block of space on the screen that is given to a character. Different computers use different numbers of pixels to create the characters, and the size of a character cell varies from one font to another. Also, in some fonts, the width of the character cell varies, based upon the width of the character itself. For example, the character cell for a W would be wider than the character cell for an I.

character code—The code that represents a specific character in a given character set such as ASCII. The codes are numeric values. For example, ASCII defines 128 characters, using numeric values from 0 to 127. In ASCII, the letter *A* is defined by the code number 65. There also are extended ASCII sets that use values from 128 to 255 in addition to the original ASCII set.

character definition table—Information stored in a computer's memory that provides a guide for the machine to use

when it creates bit-mapped, on-screen characters.

character density—The number of characters in a given space on the screen or printed page. One example is characters per inch (cpi).

character device—Any computer device that sends or receives information as a stream of single characters.

character formatting—Changing the look of specific characters you've selected instead of an entire paragraph or document.

character generator—Software or hardware that translates a character code such as ASCII into a pixel pattern to display the characters on the monitor or print them. These devices and programs usually support a limited number of fonts, compared to systems that support bit-mapped fonts. See **character code**.

character image—The pattern of bits that forms a character.

character map—Information stored in memory used to re-create text-based graphics.

character matrix—The rectangular array of dots that can be turned on or off individually to create an on-screen character.

character mode—A data transmission mode in which information is sent one character at a time.

character printer—A printer that prints one character at a time, instead of a line or a page. Daisy-wheel printers and standard dot matrix printers are both character printers. Can refer to a printer that prints text only, not graphics.

character recognition—The process of translating shapes that have been read by a computer (with a device such as a scanner) into information the computer can understand. For example, someone might use character recognition software to turn a fax image into a word processing document that can be edited. Character recognition can be error-prone because differences in typefaces and text treatments such as bold and italic influence the way characters are shaped. However, it is a fast way to computerize large amounts of written text. Also called optical character recognition (OCR). See **optical character recognition (OCR)**.

character set—A collection of characters and symbols that are somehow related.

character string—A series of characters treated as text. Character strings can contain numbers and letters.

character style—Any attribute applied to a character, including bold, italic, underline, and all capitals.

character-based—Capable of displaying only ASCII and extended ASCII characters. See **American Standard Code for Information Interchange (ASCII)**.

character-based interface—A nongraphical interface that uses only text for interaction between the user and the computer. In this type of interface, users type commands instead of using graphical elements (icons) to give instructions to the computer. MS-DOS is a character-based interface.

character-oriented protocol—Byte-oriented protocol. A communications protocol in which data are transmitted as characters in a particular character set, or bytes, instead of as bits.

characteristic—A quality of an object. Also refers to the exponent of a floating-point number (the number following the *E* that indicates the position of the decimal point) or the integer part of a logarithm. See **floating-point notation**.

characters per inch (cpi)—The number of characters that fit in an inch of space, which is dependent upon the character's point size and width. When using a font that is monospaced, each character receives the same amount of space. When using a font with proportional spacing, it will reflect the width of each character. See **monospacing**. See **proportional spacing**.

characters per second (cps)—A measure of how quickly a device can transfer or print data.

charge-coupled device (CCD)—An instrument with semiconductors arranged so the output (electrical charge) from one semiconductor is the input of the next semiconductor. This type of array is used as the light-detecting component in many digital cameras, video cameras, and optical scanners.

chart—A graphical representation of information, as opposed to a textual representation.

chassis—The metal frame on which the electrical components of a computer system are mounted. It is similar in concept to a car's chassis.

chat—Live communication over the Internet or an online service. Unlike E-mail, with each person sending mail and waiting for a reply, chatting involves two or more people typing comments back and forth in a conversational style. As one person enters text, it appears on the other person's screen in real time. Chat rooms can be found on commercial online services such as America Online and by using Internet Relay Chat software with an Internet connection.

check bits—The series of bits used to check errors in transmissions.

check box—In graphical user interfaces, a box used to enable or disable a feature. Users click the check box to activate or deactivate the feature, placing an *X* in the box or removing the *X*.

check digit—A validation digit at the end of a code that is created by plugging the code's information into a formula. The check digit, used with credit cards and other accounts, validates digits in computerized transactions and can detect errors.

check key—One or more characters added to the end of a block of data. This key, which usually is derived from the block's information, can be used to detect errors.

checksum—A calculated value transmitted with data to check for errors in the transmission. There are several ways to calculate a checksum. In a simple example, the number of bits of information is added,

and that number is sent with the transmission. The number of bits in the message is recalculated at the receiving end, and if it matches the original checksum, the information is considered error-free. (The procedure is the same regardless of which mathematical operation is used to find a checksum.)

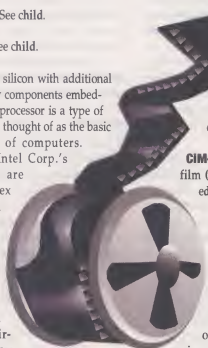
chiclet keyboard—Slang for a certain type of computer keyboard, used on the first version of the IBM PCjr system. The keyboard's small square keys resembled the brand name of the chewing gum for which the keyboard was named. Because the keys were small, spread out, and without the same feel as traditional keyboards, the keyboard was not popular.

child—A process started by another process, called the parent. It also can be a data record derived from another data record (again, the parent). For example, if the parent record is a student's academic record, a child record might be the student's grades in a particular class. See **parent/child**.

child process—See child.

child record—See child.

chip—A piece of silicon with additional electronic circuitry components embedded in it. A microprocessor is a type of chip. Chips can be thought of as the basic building blocks of computers. Some, such as Intel Corp.'s Pentium CPU, are incredibly complex and can perform many functions. Others are simple and designed only to do one task. Also called an integrated circuit. See **integrated circuit (IC)**. See **microprocessor**.



cine-oriented

chipset—A group of microchips used together to perform a single task. In personal computers chipsets are used in the computer's clock and the controllers that run the memory, hard drive, keyboard, mouse, and secondary cache, among other devices. Not to be confused with the central processing unit (CPU), chipsets control the flow of information, sorting and directing traffic on the Peripheral Component Interconnect (PCI) and Industry Standard Architecture (ISA) buses, and letting peripherals talk to each other without having to go through the CPU. See **integrated circuit (IC)**.

choose—In a graphical user interface (GUI), to select an option or command.

chop—Dropping the fractional part of a number without rounding up or down. For instance, 3-1/2, 3.7, and 3.25 can all be chopped to 3.

chord—A line that connects the two endpoints of an arc.

churn—The number of customers who switch from one service to another. Usually applied to Internet service providers (ISPs) and online services such as America Online. The average annual rate of voluntary churn, those who leave and aren't kicked off for non-payment or breaking rules, is between 10% and 30%. ISPs aim to keep the churn rate low because it's much more costly to win new customers than to retain old ones.

CIM—See **computer-input microfilm (CIM)**. See **computer-integrated manufacturing (CIM)**.

cine-oriented—When the top edge of an image is perpendicular to the long edge of a strip of images; in other words, the images connect top-to-bottom. Cine-oriented is the opposite of comic strip-oriented, in which the top edge is parallel to the long edge of a strip of images and the images connect side-to-side. A motion picture has cine-oriented images; the Sunday newspaper funnies are comic-strip oriented. Compare to **comic-strip oriented**.

cipher—An algorithm or code that can be used to encrypt data. See **encrypt**.

cipher text—Encrypted or encoded data. Data are changed into this code for security reasons; it isn't readable without the appropriate password to decode it.

circuit—The path followed by electricity as it travels from the electrical source to the electrical device. The term also could refer to a set of electronic components designed to perform a specific function.

circuit analyzer—A device used to evaluate electrical circuits. The aspects of the circuit usually measured are voltage, current, and resistance. One example is an oscilloscope.

circuit board—A board to which electrical components are connected. These components are interconnected to form a circuit. Modern circuit boards are made of an insulating material (usually epoxy and phenolic resin) and usually use copper foil to connect the components. Circuit boards may have layers of foil on one or both sides and sometimes within the board itself.

circuit breaker—An electrical device that prevents an overload by breaking or opening a circuit. Circuit breakers can be reset, usually by flipping a switch, after they've been tripped.

circuit card—See **circuit board**.

circuit diagram—The blueprint of a circuit.

circuit switching—Connecting communications lines, as happens in a telephone system's switching center. The sending and receiving parties are physically connected, and the line is open. Circuit switching commonly is used for modem communications on the dial-up telephone network, as well as in some private communications networks.

circular list—A chained or linked list in which processing takes place in all the items in the list and then returns to the starting point. In other words, the first and last items are linked together. This is different from a linear list, in which each element points to the next, except for the last.

circular reference—A series of references in which the last reference points back

to a previous reference in the same series. Alternately, a circular reference can mean a data entry mistake, usually in a spreadsheet, in which a formula is told to act upon itself or an element of itself. For example, setting a formula that multiplies two cells and then asking that the result be placed in one of those two cells is a circular reference and probably was a typing error.

circularity—See **circular reference**.

CISC—See **complex instruction set computing (CISC)**.

clamshell—The popular design for portable computers, with a shallow case hinged at the back so the screen folds up from the keyboard.

clean boot—Starting a computer using a minimal set of files. Clean boots are used to troubleshoot PCs because they eliminate any unnecessary device drivers or other problematic components.

clean install—The act of installing software on a system that doesn't already have a previous version of the software.

clean ROM—See **dirty ROM**.

clean room—A closed-in area containing sensitive equipment. The air is filtered to keep out dust and other particles, and people wear protective clothing to avoid inadvertently contaminating the equipment. The computer facilities of many companies, particularly those with important data such as customer accounts, are set up as clean rooms, as are areas where highly sensitive equipment such as microprocessors are made.

clear—Erase, or set back to the default position. The term often is used in connection with clearing a screen, which erases its contents and sets the cursor back to the top left corner. The DOS command CLS performs this function in that operating system.

clear to send (CTS)—During serial communication (the transmission of information between computers or between a computer and a peripheral device such as a printer), the CTS is a hardware signal that indicates the receiving unit is ready to accept the information from the sending unit.

click—Using a mouse by pressing and releasing its button one time without moving the mouse. This action is used to select objects in a graphical user interface (GUI). For example, an instruction might say Click the OK button. See **double-click**.

click-and-drag—See **drag**.

click-through—To click an advertisement and go to an advertiser's or another company's Web site. The number of times users click-through is used by advertisers as a gauge of how effective their advertising is. It's also often how they determine how much to pay the Web sites on which they advertise—the more click-throughs, the more an advertiser is willing to pay.

client—In a local-area network (LAN), a computer that retrieves information from or uses resources provided by the server. Unlike a "dumb" terminal used to access information from a mainframe in older systems, a client is capable of running applications and is a complete computer system in its own right. More generally, a client is a program or task that calls upon a service provided by another program. See **local-area network (LAN)**.

client/server architecture—See **client/server network**.

client/server network—A network arrangement with a server and one or more clients. Both the server and the clients are complete, standalone computers. The server can be a personal computer, minicomputer, or mainframe, and it provides resources such as data management and allows clients to share information with each other. Also called client/server architecture. Compare to **peer-to-peer network**.

clip art—Predesigned art for use in documents. The term originates from books of art out of which people literally clipped pictures to paste onto their documents. Clip art is included in many programs, including Microsoft PowerPoint and Microsoft Publisher. Software packages of clip art can be purchased for use with other programs.

clipboard—A memory feature in several operating systems, including Windows, where the last information that was copied or cut (but not deleted) is stored. This is useful when transferring information within a document or between documents. However, the clipboard can hold only one item at a time, so if a second item is copied or cut, the original one is erased. See **cut and paste**.

clipboard computer—A portable computer that is similar to a clipboard, with a flat display and a pen for input. These computers are used, for example, by delivery personnel who must obtain the signature of the recipient upon delivery of a package. Data entered into a clipboard computer, such as a signature, are transferred to another computer at a later point, either by modem or via a cable.

clipping—In computer graphics, cropping the part of the image that lies outside a boundary set by the user. Programs that allow screen shots (graphics showing the appearance of the computer screen at the time you take the shot) often let a user clip the image to show only an active window or part of the screen. Depending upon the program, clipping can be done either through a dialog box or by drawing a line around part of the image. Also called scissoring.

clipping path—The line or shape that determines which part of an image will be clipped and what part will be retained. See **clipping**.

clock—One of two kinds of clocks in most computers. The first is a real-time clock, which keeps track of time just like a wall clock or wristwatch and often includes the date. This clock usually is battery-operated, so it continues working when the computer is turned off. The second kind is the system clock, which actually is a circuit that generates a series of pulses that pace the electronic system within the computer, synchronizing the circuits and operations.

clock pulse—An individual vibration of the quartz crystal contained in the system clock. Each vibration emits a volt of electrical current. The frequency at which these vibrations occurs is the clock speed. See **clock speed**.

clock rate—See **clock speed**.

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clock speed—The rate at which the system clock paces, synchronizes, and coordinates the operations of the computer's circuits. The clock speed is one of the main determinants in how fast the system processes data. An electrical current triggers vibrations in a quartz crystal, which is in the system clock. The rhythm of the vibrations keeps the system operating at a regular, rapid pace. The clock speed is measured in megahertz (MHz). It should be noted that clock speed differs from the other speeds in a computer, including the processing speed of the microprocessor and the data retrieval speed of the hard drive. However, the operating speeds of the microprocessor and the hard drive are partly determined by the speed of the system clock.

clock tick—The smallest unit of time recognized by the CPU. Also called CPU cycle.

clock-doubling—Clock-doubling, a technology used in some microprocessors, lets the microprocessor process instructions and information at a speed twice that of the bus speed, which is the speed of the rest of the computer system. One common clock-doubled CPU is Intel Corp.'s Pentium 120MHz, which uses a 60MHz bus speed.

clock/calendar—A special circuit in a microprocessor that keeps the correct time and date. The circuit is battery-powered, so it stays on when the computer is off. The date and time mark when files were created or last revised.

clocking—See synchronization.

clone—A computer that is compatible with a better-known computer. Clones have the same architecture as the computers after which they are modeled and run the same programs. Compatibles, on the other hand, are not necessarily the same internally but are capable of running the same software as an original. Sometimes, a clone will not be identical to the original, and this may cause problems. For example, a sound card that is a clone of the popular SoundBlaster may not be 100% compatible with all software that requires a SoundBlaster sound card.

close—To exit a file or program. In text-based operating systems this action often was called exiting or escaping, but in graphical user interfaces (GUIs) such as Windows, close sometimes is used when the operator exits by closing the window in which the program is running. Closing a window removes it from the screen and ends the program.

closed architecture—A computer design whose specifications aren't available to other vendors. This proprietary practice makes it difficult for other manufacturers to create peripheral devices that are fully compatible with the system. Alternately, this term can refer to a computer system that has no expansion slots and therefore can't be upgraded by adding circuit boards. Compare to **open architecture**.

closed file—A file not currently being used by an application.

closed shop—A computer center where access is limited to data processing staff members. System users must go through the staff of the computer center.

cloth ribbon—A type of printing ribbon used with impact printers and typewriters. An inked cloth ribbon, either attached to a spool or contained in a cartridge, advances with each character. The ink is transferred from the ribbon to the paper when the ribbon is struck against the paper with the print mechanism. Cloth ribbons don't produce type as crisp as that of film ribbons. Compare to **carbon ribbon**.

cluster—A group of disk sectors (usually two to eight) treated as one entity by the operating system or a disk controller. This term sometimes refers to a group of computer terminals connected to a computer system or controller.

CLV—See **constant linear velocity (CLV)**.

CMI—See **computer-managed instruction (CMI)**.

CMOS—See **complementary metal-oxide semiconductor (CMOS)**.

CMOS RAM—A low-power memory area used to maintain the system configuration information. The contents are maintained by a battery.

CMY—See **cyan-magenta-yellow (CMY)**.

CMYK—See **cyan-magenta-yellow-black (CMYK)**.

coaxial cable

coaxial cable—A cable used in audio, video, and communications. This cable has a high bandwidth, or greater transmission capacity, than other cable types. Coaxial cable is shielded against electrical interference by a covering of braided wire. Also referred to as coax cable.

COBOL—See **Common Business-Oriented Language (COBOL)**.

code—The contents of a program, of which there are two basic kinds. Source code is written by programmers that a person can read. Machine code is a set of instructions in a format readable by the computer. Also can be used as a verb, as in to write program instructions. See **machine language**.

code page—In MS-DOS 3.3 and higher, a table used to designate character sets and keyboard layouts used in different countries. It relates the binary codes for the characters to the on-screen images and to the keyboard keys. Code pages let users configure devices, such as the keyboard, to use a specific code page, thereby allowing the user to remap the keyboard for other languages.

codec—See **compressor/decompressor (codec)**.

coding—See **programming**.

cold boot—To turn on the computer after it has been shut off. Also called cold start. Compare to **warm boot**. See **boot**.

cold fault—An error that takes place after starting a computer. This failure usually is caused by a misalignment within the

computer by the expansions and contractions that occur because of temperature fluctuations when the computer is turned on and off. To avoid this, some users leave the computer running when not in use and only shut off the monitor.

cold start—See **cold boot**.

collapse—To change the view of a hierarchical listing so only the root of each branch displays. For example, a user might collapse a detailed outline in a word processing document so only the main headings are shown. In Windows File Manager, file listings can be collapsed so only the main folders appear rather than both the folders and the files they contain. Compare to **expand**.

collate—To merge two or more similarly ordered sets into one new set. For example, if you collated two chronologically ordered lists, the new list would maintain chronological order while combining the two lists. Also called collating sort.

collating sort—See **collate**.

collation sequence—The order or sequence that is to be maintained or established by a collating sort. See **collate**.

collator—Something that merges records into a single group in the correct order. This can be a hardware device that merges physical records, such as paper or cards, or software that merges information such as database records.

collision—The result of two computers on a network attempting to send information or access a network resource at the same time. When this happens, both signals are destroyed and must be retransmitted. Most networks have some kind of built-in collision detection to avoid this problem. See **collision detection**.

collision detection—The process by which a network communication line is monitored for collisions. See **carrier sense multiple access/collision avoidance** (CSMA/CA). See **carrier sense multiple access/collision detection** (CSMA/CD). See **collision**.

colon (:)—When it follows a letter, this character indicates a disk drive. For example, C: designates the C drive, usually the hard drive. Because of this, the colon cannot be used in file, folder, or document names.

color code—The numeric value that represents a given color in a graphics system. The codes might differ from one operating system to another.

color depth—The number of different colors a piece of software or hardware can display. This amount is tied to the number of bits used for each pixel. For example, a device that uses 16 bits per pixel (such as a 16-bit video adapter) can show 216 (about 16.7 million) colors. See **pixel**.

color model—Any system used to represent color. The models commonly used in computer graphics are CMY (cyan, magenta, and yellow), RGB (red, green, and blue), and HSB (hue, saturation, and brightness).

color monitor—A computer screen that can display colors, instead of just black and white or another monochrome color scheme.

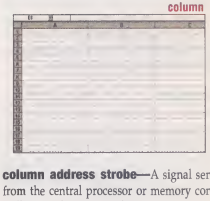
color printer—A printer that can produce full-color output. Most color printers use the CMYK (cyan, magenta, yellow, black) color model. Many color inkjet printers aimed at the consumer market do not use black ink but instead combine the other colors (CMY) to form black. This often results in a grayish black. More expensive printers include all four colors.

color saturation—Literally, the degree of "color" in a color. Higher saturation means a higher degree of color.

color transparency—An image on transparent film that produces a normal, positive picture when light is shone through it. A photographic slide, for instance, is a color transparency. Photographic negatives are the opposite of transparencies.

color/graphics adapter (CGA)—An early IBM video adapter board. Compared to more current video adapters, CGA is fairly crude. CGA cards are capable of 16 colors but have poor resolution. Even in monochrome (one color) mode, a monitor using a CGA can only display at a resolution of 640 horizontal pixels by 200 vertical pixels. At that resolution, graphics are blocky and text is fuzzy. By contrast, VGA systems have a resolution of 720 x 400; Super VGA has up to 1600 x 1200 pixels.

column—A set of items arranged in a vertical line. An example is a set of cells in a spreadsheet, going from the top to the bottom.



column address strobe—A signal sent from the central processor or memory controller to a dynamic random access memory circuit that tells it which column a particular bit of data is in. It's used in conjunction with the row address strobe (RAS) to pinpoint the location of information in a row-column memory matrix.

column chart—A way of representing data with the use of columns. Usually, the greater the height of the column, the higher the value of the data.

column graph—See **column chart**.

COM—See **communications**. See **computer-output microfilm (COM)**. See **communications port (COM port)**. See **Component Object Model (COM)**.

COM port—See **communications port (COM port)**.

Comdex—Acronym for Computer Dealers Exposition. An industry-wide computer hardware and software trade show normally held in the fall and spring of each year.

comic-strip oriented—When the top edge of an image is parallel to the long edge of a strip of images; in other words, the images connect side-to-side. Comic strip-oriented is the opposite of cine-oriented, in which the top edge of an image is perpendicular to the long edge of a strip of images, and the images connect top-to-bottom. A motion picture has

cine-oriented images; the Sunday funnies are comic strip-oriented. Compare to **cine-oriented**.

comic-strip oriented

comma-delimited—Separated into fields by commas. Comma-delimited files often are used to transfer database files between different types of database programs because they are a universal standard. For example, to export a list of addresses from one program and import it into another, the list might first be saved in comma-delimited format. The second program could then convert this format.

command—An instruction to a computer program. Commands can be typed at prompts or chosen from menus in graphical user interfaces (GUIs). For example, if you're using MS-DOS, you might type the command defrag at the command prompt to defragment your hard drive.

command buffer—A temporary storage area that holds commands until the computer can act upon them.

command button—In a graphical user interface (GUI), a rectangular box containing a command. When a user clicks the command button, the computer carries out the command.

command interpreter—See **command processor**.

command language—A limited programming language used only for executing a series of commands. Command languages include DOS batch files, structured query language (SQL), and job control language (JCL).

command line—The line on which the user types commands to be carried out by a program. This is a feature of a text-based interface such as MS-DOS, as opposed to a graphical user interface (GUI) such as Windows.

command line interpreter—See **command processor**.

command line option—See **switch**.

command mode—When a program waits for a command from a user. The term often refers to the mode in which a modem and its communication program take instructions from the keyboard or other parts of the computer system, as opposed to communications mode, in which the modem is sending and receiving data over phone lines.

command processor—A program that accepts, interprets, and acts upon commands.

command prompt—See **prompt**.

command shell—See **command processor**.

command state—When a modem is prepared to accept commands. The prefix that will send a modem into a command state usually is "AT."

command-based interface—See **command-line interface**.

command-driven system—A system in which the user types commands using the keyboard instead of choosing from a list of options, as in a menu-driven system. Compare to **menu-driven**.

command-line interface—A user interface in which the user types commands at a prompt instead of using graphical elements and menus to give instructions to the computer.

comment—Information included in a program as documentation. Depending upon the programming language, comments are indicated in a variety of ways. For example, in BASIC, a statement beginning with REM is a comment. Systems can use a single quote character, exclamation mark, or other characters to denote a comment. Comments are not translated into executable code by compilers or assemblers; they are just messages from the programmer to anyone reading the program. Comment lines sometimes can be seen in Windows' Autoexec.bat and Config.sys files and a variety of macros written for word processing, database, and spreadsheet programs.

Common Business-Oriented Language (COBOL)—A high-level programming language developed in the 1950s and 1960s. COBOL is popular for business applications designed for large computers. Because COBOL is a wordy language, its programs often are much longer than the same programs in other languages. The advantage of this wordiness is that its programs are explained in detail.

common carrier—A company, such as a phone company, that provides some kind of communications service to the public.

Common Data Format (CDF)—A file format used for storing data sets, especially data sets representing the results of scientific experiments. CDF files, developed by NASA, can be read and edited on a variety of platforms, including Windows, Macintosh, and Unix. The format is designed with platform independence in mind, which means the files can be used with a variety of operating systems.

common gateway interface (CGI) scripting—The standard for passing information between a server and an application as part of the World Wide Web's HTTP protocol. CGI is a consistent way for information to be passed from the Web server to the application program and back again. The most common use of CGI is in scripting. A CGI script is a program written with a scripting language such as Perl, Java, or C++. Rather than being compiled into machine code, scripts are interpreted. They link on-screen forms with background databases. For example, when a user views a Web page and inputs information into a form, a CGI program gathers that data and provides a response. Almost any time users are asked to input information on a Web site, a CGI script is at work. See **Hypertext Transfer Protocol (HTTP)**. See **World Wide Web (WWW)**.

Communication Act of 1934—The law that created the Federal Communications Commission (FCC), the U.S. agency that regulates interstate and international communications, including telecommunications.

communications—The exchange of information among hardware, software, and users.

communications channel—See **channel**.

communications line—A circuit or channel that carries data either within the computer or across a network.

communications link—A connection between computers that lets them exchange data.

communications network—See network.

communications parameters—Settings related to communication between computers. Examples of communications parameters are modem speed, type of parity, and numbers of data bits and stop bits. For successful communication between computers (via modems), the parameters must be set correctly.

communications port (COM port)—Serial communications ports used to connect devices such as modems and serial printers to your computer. MS-DOS versions 3.3 and newer designate four COM ports: COM1, COM2, COM3, and COM4, and then identify the devices at those ports by the port number. (Earlier versions of DOS only had COM1 and COM2.) COM1 and COM2 are the physical ports at the back of the computer. COM3 and COM4 are "virtual" ports that can be used by internal devices such as internal modems. More modern operating systems such as Windows 95 recognize additional virtual ports. You can add I/O (input/output) cards containing additional physical ports to your computer, making COM3 and COM4 accessible to external devices. See serial port.

communications program—Software used to let computers exchange information.

communications protocol—A set of rules created to help computers exchange information with as few errors as possible. Errors occur when transmission or the encoding and decoding process causes the data to be received in a form other than the form in which it was sent. The Open Systems Interconnection (OSI) model is a widely accepted standard for computer communications.

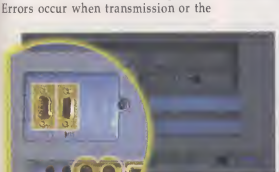
communications satellite—An orbiting satellite used to relay signals from one point on the ground to another or between other satellites. These satellites, which can maintain their position relative to Earth, receive signals, amplify them, and retransmit them on a new frequency. Such satellites are used for telephone, television, and computer data transmission, and they can handle large volumes of information. Communications satellites make possible technology such as live television broadcasts transmitted worldwide, and they are the only way to communicate in areas without a ground-based communications infrastructure.

communications server—A server PC that gives all computers on its network access to its communications lines, such as a shared modem. This server also translates packets from the network into asynchronous signals that can be transmitted over telephone lines or through serial connections. See server.

communications software—See communications program.

communications speed—The speed at which a device can transmit information, usually in terms of bits per second (bps). See data transfer rate.

communications system—The system made up of hardware, software, and connections necessary for data communications.



communications port

compact disc (CD)—A flat, round storage medium read by a laser beam and used to store digital data, particularly audio. (One 4.75-inch CD can hold up to 72 minutes of music.) See **CD-ROM**. See optical disc.

compact disc, read-only memory (CD-ROM)—(Pronounced see-dee-romm.) A storage medium using CDs to hold computer data. A CD can hold about 650MB of data, or about 300,000 pages of text. This capacity is roughly that of 700 diskettes. CD-ROMs can't be erased and reused, as can diskettes. However, because of the much larger storage capacity, CD-ROMs are suited to the storage of information that requires large amounts of storage space such as sound, color graphics, and video. CD-ROMs are often used for games and multimedia software.

compaction—The act of defragmenting information stored in memory, thereby arranging data so the largest free space possible is created.

compandor—Hardware that improves transmission performance in telecommunications by compressing the outgoing signal and expanding the incoming signal.

compare—To examine two pieces of data for differences.

compatibility—A measure of how well two or more devices (hardware or software) work together. For example, two programs are compatible if a file created in one can be read in the other. Compatibility also can refer to how compliant a device or program is with a standard.

compatibility box—A window in OS/2 that simulates MS-DOS, letting the user run DOS programs. Also called DOS mode.

compatibility mode—A mode in which a system supports software from another system. For example, Windows 95 has an MS-DOS mode that lets users run DOS programs.

compatible—The ability of computer components to work together. See compatibility.

compile—To translate the source code of a programming language such as C into the basic machine language that computers understand. Programs used to compile programs are called compilers.

compiler—A computer's interpreter. A program that changes the high-level source code of a programming language such as C into the basic machine language a computer understands. High level programming languages come with compilers.

complement—A number that is the mirror image of another number in the same base, such as base 10. For example, -3 is the complement of 3.

complementary metal-oxide semiconductor (CMOS)—An electronic component used for RAM and fast data switching. CMOS semiconductors are made of two metal-oxide field effect transistors for high speed and low power use. However, they can be damaged by static electricity. See **metal-oxide semiconductor (MOS)**. See **metal-oxide semiconductor field-effect transistor (MOSFET)**.

complex instruction set chip—See **complex instruction set computing (CISC)**.

complex instruction set computing (CISC)—(Pronounced sisk.) A processor architecture that maximizes the number of instructions carried out by the processor. This type of processor places the processing burden on hardware instead of software. A CISC processor supports up to 200 instructions. Most PCs use this architecture but some use reduced instruction set computing (RISC, pronounced risk), which supports fewer instructions. See **reduced instruction set computing (RISC)**.

Component Object Model (COM)—A binary code model created by Microsoft Corp. that helps programmers build software components that can be used to create new programs or add improvements to existing software. It is the foundation for object linking and embedding (OLE), ActiveX, and DirectX. See **binary**.

composite display—A video display that extracts images from composite signals. Composite signals carry all necessary video information, such as color and horizontal and vertical scanning, in the same signal rather than in different signals. Compare to **red-green-blue monitor**.

compound document—A document that contains data from two or more applications. For example, a word processing document that contains a chart from a spreadsheet program is a compound document.

compress—See **data compression**.

compressed file—A file that has had its contents compressed so it takes up less space in storage. See **data compression**.

compression—See **data compression**.

compression utility—A program (such as PKZIP or Stacker) that compresses files. See **data compression**.

compressor/decompressor (codec)—Any technology used to compress and decompress data, which can be done with hardware, software, or a combination of the two. Different technologies perform this in different ways. For example, MPEG is a video codec, named for the Motion Picture Experts Group, that compresses full-motion digital video, and it requires special hardware for decompression.

computation-bound—A computer affliction in which the CPU is loaded with too many calculations, causing the computer to freeze.

compute—Generally, to perform any kind of calculation. In reference to personal computing, to use a computer.

computer—A machine that accepts input, processes it according to specified rules, and produces output. The ENIAC, a massive calculator built during World War II that was one of the first electronic computers, and other early computers were based upon vacuum tubes. In the early 1960s, transistors replaced the vacuum tubes, and later that decade, integrated circuits replaced the individual transistors. By the mid-1970s, it became possible to incorporate thousands of circuits onto a single chip. This allowed smaller, faster, inexpensive computers to spread in businesses and homes. Computers today are much more advanced than their early predecessors and can perform operations thousands of times more complex.

computer art—Art created on a computer by a person or generated by a computer. Computer art generally is considered easier to create than traditional forms of artwork, but some argue that computer art is not as personal and not as creative.

computer center—A facility that provides computing resources and services to a group of people such as employees of a company.

computer conferencing—Communication among people at different locations using computers connected through communications services and equipment. Computer conferencing lets many people share the same information at one time. For example, a person in a branch office who needs to share information with corporate headquarters in another city can use computer conferencing to communicate.

computer control console—See **console**.

computer crime—Any illegal or unauthorized use of a computer. Breaking into a company's computer system and downloading files is a computer crime as is using a computer to change information in a record such as a bank account.

computer engineering—A branch of electrical engineering involving the design and development of computers and related hardware. In one of the first computers, the ENIAC, engineers had to rewire the machine to change the computer's instructions. Later computers were designed so instructions were instead changed through software. From then on, engineers played a smaller role in the day-to-day use of computers and a larger role in the design and development of the equipment.

computer family—A group of computers with the same or related microprocessors and design features. Computers within a family are more compatible than computers in different families. For example, computers based on the 80x86 line of Intel Corp. microprocessors (such as the 80286, 80386, and 80486) can run much of the same software. However, they cannot run software designed for computers based upon the Motorola 88000 line of microprocessors.

computer game—Any game played using a computer. Many computer games are simulations in which players pretend to fly a plane, fight battles, or drive a car. Others are computerized versions of card or board games. The multimedia capabilities of today's computers make the games increasingly complex and realistic.

However, some games require large amounts of memory and a fast CPU, making them worth playing only on the latest equipment.

computer graphics—The display of pictures on a computer screen.

computer graphics interface (CGI)—A software standard for computer graphics devices that makes it possible for programmers to work with computer graphics. It also allows the same language to be used regardless of the output device.

computer graphics metafile (CGM)—A file format for object-oriented graphics images. It is used for exchanging graphics files among programs.

computer instruction—Any instruction that can be recognized and carried out by a computer. The term also can refer to the use of a computer in an educational setting.

computer instruction code—See machine language.

computer interface unit—See interface.

computer language—See programming language.

computer letter—See form letter.

computer literacy—Familiarity with computers, including general knowledge and practical ability. If someone uses several different kinds of computer programs, understands basic file structure, and knows how computer components work together, that person probably is computer literate, but degrees of computer literacy vary.

computer name—The identifying name given to a computer on a network. Each computer has a unique name, which is different from a username that identifies a specific person. The computer's name identifies the computer and its resources to other computers on the network. See network.

computer network—See network.

computer power—A measurement of how a computer performs. One common measurement is the number of instructions the system can carry out in a second, usually in millions of instructions per second (MIPS) or millions of floating-point operations per second (MFLOPS). Other measurements are the amount of RAM, the processor speed, and the number of bits the computer can handle at once. Computer power is difficult to determine because different systems perform different tasks with more or less efficiency.

computer system

computer program—See program.

computer revolution—A term describing the widespread use of PCs. The revolution aspect is based upon how quickly computers became popular for individual use along with how dramatically they changed the way information is handled. We are now said to be living in a "computer age" because of the effect computers have on everyday life, from storing driving records to recording prices at the supermarket checkout lane.

computer science—The study of computers, including how they are designed and how they operate. Topics range from simple programming techniques to artificial intelligence research.

computer security—The protection of computers and the information contained in them from unauthorized access. Data protection involves backing up all data and keeping the copies in a safe place. Passwords are a common computer security measure. Without computer security, anyone would be able to access, add, remove, or alter files, causing data loss or more subtle changes such as inaccurate data. See cryptography.

computer simulation—See simulation.

computer system—A computer and all its peripheral devices. A typical system includes the computer unit with hard drive and disk drive(s), a keyboard, monitor, and mouse. Other parts of a system include printers, modems, and alternate input devices such as trackballs and joysticks.

computer typesetting—The format of text and/or digitized graphics controlled in part, or entirely, on computers. This eliminates the need for information to be physically pasted together and also allows changes to be made more easily.

computer user group—See user group.

computer utility—See utility.

computer virus—See virus.

computer-aided design (CAD)—The use of computers to design various engineering, architectural, and industrial objects. Also refers to the software and hardware used to design models of those products.

computer-aided design and drafting (CADD)—The use of computers to design engineering, architectural, and industrial objects, and enter text and figure dimensions.

computer-aided design/computer-aided manufacturing (CAD/CAM)—The use of computers in both the design and manufacturing processes of a product. The product is designed on a computer using a CAD program, and it's manufactured with the use of other computers dedicated to the assembly stage of the manufacturing process.

computer-aided engineering (CAE)—The use of software to test engineering designs created on computers. Also can refer to applications that analyze the designs.

computer-aided instruction (CAI)—The use of software in teaching, including learning tools such as tutorials and tests. The interactive nature of these programs lets students learn at an individual pace.

C

computer-aided manufacturing (CAM)—The use of computers to automate the manufacturing process, particularly the fabrication, assembly, and control aspects of manufacturing. CAM uses specialized programs and equipment usually controlled by computers. For example, CAM can refer to the manufacture of products using a full-blown assembly line with robotic machines programmed to perform the physical assembly of the product.

computer-aided software engineering (CASE)—The use of computers in software development. The term also can refer to software used in program development.

computer-aided testing (CAT)—The use of a computer to test designs, particularly those created using computer-aided design programs. See **computer-aided design (CAD)**.

computer-assisted—See **computer-aided**.

computer-based learning (CBL)—See **computer-aided instruction**.

computer-based training (CBT)—The use of computers to teach skills. For example, CBT lessons might be included with a software package to familiarize the new user with the software.

computer-independent language—A computer language not tied to a particular computer system. Most high-level languages, such as BASIC, are computer-independent.

computer-input microfilm (CIM)—The process in which data stored on microfilm are scanned into a computer and converted into a format that can be used by the computer.

computer-integrated manufacturing (CIM)—The use of computers and software in the manufacturing process, often including computer-aided design and computer-aided engineering.

computer-managed instruction (CMI)—The use of computers as teaching tools. This includes computer-aided instruction and computer-based training.

computer-output microfilm (COM)—Microfilm on which computer data are recorded. COM is an appropriate storage medium for items to be viewed page by page, as with magazines or newspapers. A special viewer is required to view microfilm images.

computer-readable—Able to be interpreted by a computer. Two kinds of information are considered computer-readable: data that can be scanned and read by a computer, including bar codes and magnetic tape; and machine code, the binary form of information that the microprocessor can interpret. See **machine language**.

computerized mail—See **electronic mail**.

CON—See **console**.

concatenate—Copying separate files into one file. In DOS, for example, this can be done by typing the COPY command, followed by all the pertinent file names joined by the plus (+) sign. The new file name will be the last file name in the command string.

concentrator—A device that combines communications signals from several sources, such as computers on a network, into fewer signals before transmitting them to the destination. Also can refer to a hardware device that connects several peripherals to a computer with only one line between the concentrator and the computer.

concurrent—Simultaneous; occurring at the same time. See **concurrent access**. See **concurrent execution**.

concurrent access—The use of a computer system, program, database, or other resource by more than one user at a time.

concurrent CP/M—See **control program for microprocessors**.

concurrent execution—The simultaneous execution of two or more routines or programs. Compare to **sequential execution**.

concurrent operation—An operation in which two or more programs have access to the microprocessor and are carried nearly simultaneously. Although the operations are not truly taking place at the same time, the difference between how a computer manages time and how people perceive it makes it appear simultaneous.

concurrent processing—See **concurrent operation**.

concurrent program execution—See **concurrent execution**. See **concurrent operation**.

Concurrent RDRAM—See **Rambus Dynamic random-access memory (RDRAM)**.

condensed—A font style that reduces the width of each character and places the characters closer together, allowing more characters to fit on each line.

condition—The status of an expression or variable. Examples are true, false, equal, and not equal. In some programs, instructions take place based upon whether a certain condition is true.

conditional—A term used to describe an action or procedure that occurs based upon whether a certain condition is true. The execution of the action is dependent on that condition.

conditional expression—See **Boolean**.

conductor—A material that carries electrical current. Metals are good conductors; copper is most commonly used. Computers and other electronic devices contain conductive material.

Config.sys—A text file that specifies the drivers (software that lets computers communicate with hardware) and system parameters used in MS-DOS and OS/2. Config.sys controls some aspects of the operating system's behavior, and it contains commands about how to do things such as work with new hardware or adjust memory. This file is read when the operating system loads, and the instructions in the file are carried out by the operating system loader. The file can be

changed using the operating system's editing program.

configuration—The way a computer system is set up, both physically and with software. It includes equipment, operating system, amount of memory, and so on.

configuration file—A file that establishes the user's choices for the configuration of the computer system.

Configure—To set up a computer, both hardware and software. A specific program may be customized (or configured) to meet individual needs. For example, in the Windows Control Panel, a user can adjust such things as screen colors, screen saver, mouse and keyboard response rates, and display settings.

connect charge—The amount of money a user pays for connecting to a commercial communications service such as an Internet service provider (ISP). A connect charge may be a flat monthly fee or dependent upon the amount of connect time.

connect time—The amount of time a user spends connected to a remote computer, particularly referring to how long someone is on the Internet with an online service or Internet service provider. Connect charges often are based on connect time although some have a flat monthly fee for unlimited connect time.

connectivity—Describes how well two hardware or software systems work together.

connector—The plug on the end of a cable that makes the connection to another device. The part on the device itself also is a connector, but it more often is referred to as a port because it is the socket into which a connector plugs.

connector pin—See **pin**.

consistency check—A simple check to make sure data fall within prescribed parameters.

console—The part of the computer containing the main components of the system. Sometimes the term also includes the monitor and/or the keyboard. In MS-DOS, the console is considered the keyboard and monitor, designated by the device name CON.

constant—A value that doesn't change in a given amount of time.

constant angular velocity (CAV)—A method of reading data from a CD-ROM in which the disk rotates at a constant speed. The other method of reading data from CD-ROMs, constant linear velocity (CLV), changes the rotational speed so that tracks on the inner portion of the disk can be read faster. CAV is efficient because it does not require the motor to change speeds, thereby saving the time that would be needed to change speeds. The only drawback is that inside tracks are read slower than those near the outside of the disc, and most CDs have data laid out starting on the inner tracks and working outward.

constant expression—A program expression that contains no variables. These values do not change and therefore don't need to be evaluated during program execution. Compare to **variable expression**.

constant linear velocity (CLV)—A method of reading compact discs that ensures all tracks on the CD are read at the same speed. Since fewer tracks can fit on the inside of a disc than on the outside, the disk needs to rotate faster when reading the inside of the disc and slower on the outside tracks so that data is read at a constant speed. This method is used in most music CD players and older CD-ROM drives, but constant angular velocity (CAV) drives are gaining popularity. See **constant angular velocity**.

Consultative Committee for International Telephony and Telegraphy (CCITT)—A committee of the United Nations International Telecommunications Union that is involved in the development of international data communications standards.

container program—See **object linking and embedding container**.

container tag—A pair of HTML tags that contains text or images to be displayed on the page. It has an open and a close tag. For example, to display text in bold, you would use the tag to start bolding text and the tag to stop. The text between the tags is "contained" and displayed on the screen. See **empty tag**.

contention—A conflict when more than one computer, or more than one program in a single computer, tries to access the same resource at the same time. Different systems and networks respond in different ways; some require all parties to access the information again, while others operate on a first-come, first-served basis.

contention network—A system in which the nodes of a network compete for resources, which can result in a conflict when more than one computer tries to access the same resource at the same time. Compare to **Token Ring**.

context switching—A kind of multitasking in which the computer moves from one task to another as necessary, instead of giving time to each task in its turn.

context-dependent—A term describing information that varies based upon the surrounding environment. The meaning of the data is subsequently dependent on the surroundings.

context-sensitive help—A feature in a program that gives the user information about the current command or operation without requiring the user to leave the program.

contextual search—A search in which the program lets the user enter a set of characters to search for, usually in a specific file. For example, in most word processors, a given string of characters (such as a name) can be searched for and replaced with another string.

contiguous—Side by side. Two or more items are contiguous if they are touching each other. For example, contiguous sectors on a disk are physically next to each other.

contiguous data structure—A set of information stored in consecutive memory locations.

continuous carrier—A carrier signal that stays on for the entire transmission, whether or not it carries information the entire time, as opposed to a carrier signal that is on only when transmitting data.

continuous processing—Processing transactions as they are entered into a system, as opposed to batch processing, in which transactions are processed in groups (or batches).

C

continuous tone—Made of a nearly unlimited range of shades of gray or colors. Television and photography use continuous-tone images; computer images are limited to specific colors and shades of gray. In a continuous-tone image, for example, colors or shades of gray are gradients, not clustered dots. This kind of image can only be viewed on an analog monitor, such as a standard television monitor, and not on a digital monitor, which requires the image to be broken into units.

continuous-form paper

continuous-form paper—Computer paper that is connected end-to-end so it can be fed through a printer. The pages are perforated so they can be separated after printing. Most impact printers use this paper; many printers, including inkjet printers, can use either continuous-form paper or individual sheets of paper.

contouring—Representing the quality of an object's surface in computer graphics. Shows whether an object is rough or smooth.

contrast—The difference between the light and dark areas on a monitor. Compare to brightness.

control alt delete—See CTRL-ALT-DEL key combination.

control break—See CTRL-BREAK key combination.

control character—A special character that controls a specific action in devices such as monitors and printers. Examples are the backspace, carriage return, and linefeed characters. The first 32 characters in the ASCII set generally are considered control characters

control console—See console.

control key—A key that changes the meaning or function of other keys when used in combination with them. For an example, see **CTRL key**.

control key sequence—A combination of the CTRL (control) key and at least one other key to perform a specific function. See **CTRL key**.

control menu—In Windows, a menu that lets users perform window-related operations such as moving the window, changing its size, or closing it.

Control Panel—A program in Windows that lets the user modify some aspects of the interface such as colors, fonts, keyboard, printer, sound, and screen savers. The Control Panel in Windows 3.x is in the Main Program Group; in Windows 95 and Windows 98 it is under the Start Menu's Settings option.

control program for microprocessors (CP/M)—A line of operating systems from Digital Research that was designed for Intel Corp. processor-based microcomputers and was commonly used in the 1970s and 1980s. The first in this line, CP/M-80, was the most popular operating system for the 8080- and Z80-based systems.

control unit—A regulating device or circuit. The control unit is responsible for regulating the actions (such as decoding, executing, and storing) of the component assigned to it. For example, a control unit for the printer helps the CPU keep track of the activities of the printer.

controller—A device that manages the flow of information between a computer and a peripheral device by relaying information between them. Specific devices require specific controllers. A computer comes with controllers for standard components such as a keyboard and monitor, but expansion boards with additional controllers might be needed for other devices, such as scanners and other input devices.

controller card—See adapter card.

convention—A standard, whether formal or informal, that is applied fairly universally in a given situation. For example, programming languages rely upon conventions that define the meanings of certain symbols and abbreviations.

conventional memory—In MS-DOS, the memory that can be accessed by the operating system without any special programs or drivers. This generally is the first 640KB of memory, unless the system has less total memory. Conventional memory is the only kind of RAM accessible to MS-DOS programs, unless special techniques are used to enable the programs to access other RAM. Also called base memory.

conversational—An interactive mode of operation in which a computer is interacting with the user in an exchange of commands and system responses. PCs operate in this mode.

conversational interaction—When two or more people take turns sending and receiving messages using computers.

conversion—The translation of information from one format into another. Generally refers to file conversion (changing a file from one format such as a specific word processor's file format, into another such as text format) or data conversion (changing data from one format such as binary, to another such as decimal). However, it also can mean several other types of conversion. Media conversion is the transfer of information from one storage medium to another such as from a 5.25-inch diskette to a 3.5-inch diskette. Software conversion is the changing of a program (usually by a professional) to work on a system other than that for which it was designed. System conversion means changing from one operating system to another such as migrating from DOS to Windows 98. Hardware conversion is

changing one or more physical aspects of the computer.

convert—See conversion.

converter—Hardware or software that changes information or electrical signals from one format into another for use by a system or device requiring a format other than the original.

cookbook—A set of instructions in a step-by-step format, as in a recipe. Many hardware and software manuals are written in this format, with a list of directions for installation and use of the equipment or program.

cookie—Information from a Web site sent to a browser and stored on a user's hard drive so the Web site can retrieve it later. A Web server using the technology looks for a cookie when a user visits. Cookies generally are used to identify visitors. A cookie can contain information about the user's login name, password, and preferences. For subscription sites, the cookie can make it unnecessary to log in each time. Users have the option to configure their browsers to either accept or reject cookies

cookies—See cookie.

cooperative multitasking—Multitasking in which a program running in the background can only receive processing time when the program in the foreground permits it. This is the predominant way the Apple Macintosh system performs multitasking. Compare to **pre-emptive multitasking**. See **multitasking**.

cooperative processing—An operation mode in which multiple computers work on different parts of the same program or on the same data.

coprocessor—An additional processor chip added to the bus to extend the base architecture and instruction set of a microprocessor. Common examples are specialized chips that handle math or graphics operations. For example, a math coprocessor handles advanced mathematics functions for the CPU, freeing it to perform other operations and operate more quickly and efficiently. One coprocessor is Intel Corp.'s 80387, which was designed to work with the 80386SX.

copy—To duplicate. When a user copies data, a file, or a diskette, the end result also is called a copy. In Windows, the Copy command (in the Edit menu) places a copy of the highlighted text and/or graphics onto the clipboard for transfer to another document or another location within the same document. The Copy command in the File menu of File Manager copies an entire file or directory to a new location. Compare to **cut**. Compare to **delete**.

copy holder—A device that holds printed material so a user can view it easily while working on the computer.

copy holder

copy program—A program that copies files to a new location, or one that disables copy protection, allowing software to be copied illegally. The COPY command in DOS is an example of a program used to copy files from one location to another.

copy protection—Hardware or software that protects programs from being copied without authorization. Copying commercial software for reasons other than personal use is a violation of software licensing agreements and is illegal.

core—A type of computer memory that was popular before RAM became widely used and affordable. It received its name from the small magnetized circles, or cores, in which data were temporarily stored.

core program—Any program in RAM.

coresident—Describes two or more programs that reside in memory at the same time. This term can be used to describe two or more things in the same place (such as a computer or a network).

coroutine—A routine that is in memory at the same time as another routine and often is carried out at the same time as the other routine. See **routine**.

corrective maintenance—Diagnosing and fixing computer problems instead of preventing them.

correspondence quality—See **print quality**.

corrupt—To alter or partially erase information in memory or a file, rendering it unusable by the computer. Hardware or software failure can corrupt a file by rearranging the bits of data. Corrupted information no longer is readable.

corruption—The damage or alteration of data or programs because of hardware malfunction, software failure, viruses, power failure, human error, or deliberate sabotage.

counter—A variable that tracks how many times an activity has occurred.

counting loop—A program routine that is repeated a specified number of times. A counter variable is increased by one each time the routine is performed. When the variable reaches a certain number, the routine ends.

country-specific—Uses characters or conventions unique to a particular country. Country-specific features of a computer system include keyboard layout, time and date conventions, and alphabetic sorting order.

courseware—Educational or training software used in schools or other training facilities to teach about a specific topic.

CP/M—See **control program for microprocessors**.

cpi—See **characters per inch**.

CPL—See **current privilege level**.

cps—See **characters per second**.

CPU—See **central processing unit**.

CPU cycle—The smallest unit of time recognized by the CPU. Also called clock tick.

CPU time—The amount of time a given process has control of the CPU.

CPU-bound—See **computation-bound**.

CR—See **carriage return**.

cr/lf—See **carriage return/line feed**.

cracker—A person proficient at deciphering codes and passwords and breaking security systems for illegal or unethical reasons. The term was invented by computer hackers to replace the term "hacker," which often has been inaccurately associated with computer foul play. In fact, in many instances, "hacker" refers to a savvy computer user. Compare to **hacker**.

crash—A sudden, unexpected termination of a program caused by a hardware or software error. Usually a user must reboot the system to attempt to recover. A crash may indicate a large problem. Entire systems crash, while applications are said to bomb.

CRC—See **cyclic redundancy check**.

critical error—An error so serious that it is impossible for the current program to continue. In MS-DOS, this generally causes the "Abort, Retry, Fail" message.

critical error handler—The portion of the MS-DOS operating system invoked when a critical error occurs. The critical error handler issues the "Abort, Retry, Fail" message on the screen. See **critical error**.

crop—To trim an image to refine it for use in a document. Backgrounds, individuals, or objects may be cropped out of pictures. Cropping may result in a less-cluttered or more powerful image, but it also can create a misleading picture.

crop marks—Lines that mark where an item, usually an image, will be cropped. See **crop**.

cross hairs—A set of crossed lines that takes the place of the cursor in some programs. An operation will take place at the point of the intersection.

cross-platform—Describes hardware or software that can run equally well on different platforms. One example is the Netscape Navigator Web browser, a program available for more than a dozen types of computers. Much of today's software is written for one of three main platforms: the IBM-compatible PC, the Apple Macintosh, and various varieties of the Unix operating system. See **platform**.

crosshatching—A criss-crossed pattern of shading used to distinguish one part of a monochrome graphic (an image that uses only one color such as black on white or green on black) from another.

crosstalk—In communications, the term describing the interference caused by an adjacent channel. Interference often is caused by two signals crossing. Crosstalk can cause errors in the transmission of data but can be reduced by employing shielded cables and/or moving conductors farther apart.

CRT—See **cathode-ray tube**.

CRT controller—The part of the video adapter board that generates the video signal.

crunch—To process information. A number cruncher is a device or routine designed for rapid processing of numbers.

cryptography—The discipline of encoding and decoding information. Information on computers often is encoded for security reasons. See **computer security**.

CSMA/CA—See **carrier sense multiple access/collision avoidance**.

CSMA/CD—See **carrier sense multiple access/collision detection**.

CSS—See **cascading style sheets**.

CTD—See **cumulative trauma disorder**.

CTRL key—A key on a computer keyboard that, when used in conjunction with other keys, gives a key a function other than its labeled one. For example, in Microsoft Word, pressing the CTRL key with ALT and the minus sign (-) on the numeric keypad produces a long dash (—). The CTRL key generally is on each of the lower corners of the main section on a keyboard.

CTRL-ALT-DEL key combination—A method of rebooting IBM and compatible computers. Pressing the three keys at once causes the system to restart (known as a warm boot). This may be done in response to a system prompt; other times it is used when a system locks up. See **boot**.

CTRL-BREAK key combination—A command that stops a currently running program or batch file.

CTRL-C key combination—A command that cancels a running program or batch file.

CTS—See **clear to send**.

cumulative trauma disorder (CTD)—An injury associated with long hours of repetitive movements (such as typing) without letting the muscles recuperate. Carpal tunnel syndrome is one example. CTDs can be prevented by practicing ergonomics—fitting the workplace to the worker, instead of the other way around. For example, wrists should be supported in a natural, comfortable position. Injuries also can be avoided by taking breaks from the repetitive action and doing appropriate exercises. Also called repetitive stress injury. See **ergonomics**.

current—The flow of electricity through a conductor.

current directory—The open directory in which a user currently is working. When commands are executed within a directory that will affect that directory or its files, the commands can be typed without a path name. Also called the **working directory**.

current drive—The disk drive with which a user currently is working.

current location counter—See **program counter**.

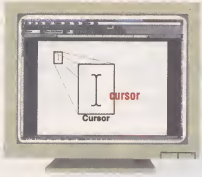
current privilege level (CPL)—The access rights, or privilege level, a running program has to a directory, file, or other program. The program might not be able to read a file outside of its CPL.

current record—The database entry currently selected for an operation such as edit, display, delete, or print.

cursor—A marker on-screen that shows where current input or output is going to happen. It may appear as a blinking vertical line, a solid or blinking box, an underline, or a caret.

cursor control (CC)—The user's ability to move the cursor on the screen. Several arrow keys on the keyboard are dedicated to cursor control. See **cursor keys**.

cursor keys—The keys on a keyboard that control the on-screen movement of the cursor. Common cursor keys are the four arrows (which move the cursor one position in the direction the arrow is pointing) and the HOME, END, PAGE UP, and PAGE DOWN keys. The HOME key returns the cursor to the beginning of the current line or input field. The END key moves the cursor to the end of the current line or input field. The PAGE UP and PAGE DOWN keys move the cursor up or down one full screen from its current position. Also called direction keys.



cursor position—The location of the cursor on the screen. In text mode, this location is represented by a line number and character number and will be where the next typed character appears.

custom software—A program developed to perform a specific task for a specific client. For example, a company might have someone design a specific program to handle its billing and invoice system. Compare to **canned software**. See **packaged software**.

customer support—Service for end users (customers) provided by computer vendors and hardware and software manufacturers. End users turn to customer support when their systems or programs aren't working. Many companies offer toll-free customer support lines, but customers often complain it is difficult to get through, that they spend a long time on hold, and that they are charged for assistance. Also called technical support.

customize—To modify or set up hardware and software according to an individual's preferences.

cut—To remove something such as part of a text document, an icon, graphic, or other feature appearing on-screen. In Windows, whatever is cut is placed in the clipboard until it is replaced by something else being cut or copied. Items that are cut disappear from their original location but can be pasted into another location as long as they still are on the clipboard. Compare to **copy**. Compare to **delete**. See **clipboard**. See **cut and paste**. See **paste**.

cut and paste—To reorganize a document or move data from one document to another. The process involves selecting information to be moved, cutting it (which moves it from its current location to the clipboard), and then pasting it in a different location. This is the computer version of cutting something out of one piece of paper and affixing it to another. See **clipboard**.

cut-sheet feeder—See **sheet feeder**.

cyan-magenta-yellow (CMY)—A color model based on subtractive primary colors rather than additive colors. The model uses white as a base and removes percentages of cyan, magenta, and yellow to reach a certain color. Removing 100% of all the colors leaves black. The CMY model is preferred over the red-green-blue (RGB) model for printing work. Compare to **red-green-blue (RGB)**. See **cyan-magenta-yellow-black (CMYK)**.

cyan-magenta-yellow-black (CMYK)—A color model similar to cyan-magenta-yellow but with an added black component. It produces deeper blacks than a combination of the three primary colors.

cyber—A prefix that generally means "having to do with computers" and used especially in connection with the Internet. See **cybernetics**. See **cyberspace**.

cybernetics—The science branch that examines the workings of humans and machinery, both similarities and differences. For example, the computer's electronic system might be compared to a human being's nervous system.

cyberspace—Not a real location but rather the "world" created by computers and specifically the Internet. In this virtual space, people can do many of the things they do in physical space: interact with other people, shop, read the news, etc. Computer games often create a specialized cyberspace the user enters while playing the game, and all the action of the game occurs in that world.

cycle—One occurrence of a repeating event.

cycle time—The amount of time between one RAM access and the next.

cycles per second—See **hertz**.

cyclic redundancy check (CRC)—A method of ensuring accurate data transmission. The sending device uses aspects of the data to be transmitted to generate a number based on complex formulas. The receiving device runs the same data through the same formula. If the two results do not match, the data must have been altered en route. In such cases the receiving device then asks for a retransmission of that data. Protocols that use CRC are more accurate but slower than protocols without error-checking.

cylinder—A set of corresponding tracks on a fixed or removable disk. Each cylinder is made up of the tracks that the read-write head can access from a certain position without moving. To put it another way, cylinders comprise the tracks on both the top and bottom of all platters with a certain radius from the center point. See **fixed disk**. See **head**. See **platter**.

D

D:—When followed by a colon, D refers to the D: drive. In most IBM-compatible computer systems, this is the CD-ROM drive; however, drive letters can be reassigned by the user.

D-A converter—See **digital-to-analog converter (DAC)**.

DAC—See **digital-to-analog converter (DAC)**.

DAE—See **digital audio extraction**.

daemon—A program that runs in the background without being triggered by a user. Daemons might be stimulated into action by an event, or they might operate according to a timed schedule. Some word processing programs have a daemon feature that automatically saves an open document at predetermined intervals.

D

daisy chain—A set of hardware components connected to each other in a series. The first component connects to the computer, the second component connects to the first, and so on. Signals are passed from the computer to the first device and on through the line. To limit confusion, each device is given a different priority to use the channel to which they are all connected, or they transmit information only when they "hear" that the line is clear. This eliminates disorder and conflicting requests. The Small Computer System Interface (SCSI), for example, is a daisy chain system that supports up to seven devices. "Daisy chain" also is used as a verb to describe the action of connecting devices in that pattern. See **Small Computer System Interface (SCSI)**.

daisy chain

daisywheel—A printing mechanism shaped like a round disk with a number of spokes, or arms, that extend from its center. Each arm has a fully formed character on its tip. The arm hits the ribbon, and the impact makes a mark on the paper. One daisywheel contains all the characters for one font only; a change in fonts requires a different daisywheel. Daisywheels are found on a daisywheel printer. Also called print wheel.

damping—A technique that stifles the response of a circuit or device so it does not exceed certain limits. Damping is used to pace the flow of electricity or information within the computer.

DAO—See **data access objects (DAO)**.

DARPA—See **Defense Advanced Research Projects Agency (DARPA)**.

DASD—See **direct access storage device (DASD)**.

DAT—See **digital audio tape (DAT)**. See **dynamic address translation (DAT)**.

DAT cartridge—See **digital audio tape (DAT)**.

DAT drive—See **digital audio tape (DAT) drive**.

data—Information put into a form that can be processed by a computer. Information is condensed digitally in a computer so text, picture, or sound can be represented on a screen.

data access objects (DAO)—Databases that can be modified from any of the Microsoft Office programs, such as Word, Excel, and Access. DAO makes transferring work between programs such as Word and Excel much easier. For example, if after copying part of a database into a Word document you find you need to make a correction, the correction can be made in Word instead of having to reopen the database in Excel to make the correction.

data acquisition—The act of collecting information, usually from a source outside a computer. As the information is gathered, it is condensed into a form that is readable by the computer. This condensed information, known as data, can be stored in a computer's database for later reference. A Geiger counter is one example of a device used to acquire data.

data area—The area of a hard drive or diskette that can store data and programs. When a disk is formatted, a boot record, partition table, root directory, and file-allocation table (FAT) are established first on a small portion of the disk. The larger remaining portion of the disk is considered the data area.

data bank—Any sizable collection of data.

data bit—See **bit**.

data buffer—A temporary data storage site used when data are moved between locations. See **buffer**.

data bus—The electronic transmission channels used by computers to send data to and receive data from system components. See **bus**.

data capture—The accumulation of information in a form that can be used by the computer. For instance, data capture occurs when an analog-to-digital converter translates normal audio into digital signals the computer can process and manipulate.

data carrier—In communications, any frequency that can be adjusted to transport information.

data carrier detected (DCD)—In communications, a signal that indicates to a computer that a modem is connected and ready for transmission.

data cartridge—See **digital audio tape (DAT)**.

data channel—The path data follows when traveling between two peripherals.

data collection—The act of acquiring computer data, or the set of data that is acquired.

data communication (DATACOM)—The interaction between two computers using modems, local-area networks (LANs), or direct cable access.

data communications equipment (DCE)—Any device, such as a modem, that connects a computer to a network.

data compaction—See **data compression**.

data compression—Any method of condensing information so it can be stored in less space or transmitted in less time. Many large graphics and sound files are compressed so they can be downloaded faster. Although data compression can be done in many ways, a compression program generally looks for redundancies in a file, then compresses the identical pieces of data into one representative token. Also called data compaction.

data control—In a network system, the process of managing data usage by keeping

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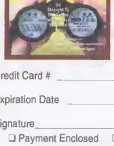

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a record of who uses the data, and when, how, and what is changed.

data conversion—Changing information from one format, such as binary, to another, such as decimal.

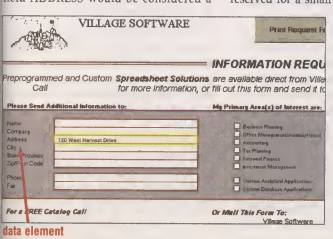
data corruption—See **corruption**.

data declaration—The programming command that indicates the characteristics of a variable.

data deletion—Erasing information that is no longer needed. In a database management system, data deletion refers to the systematic removal of specific data from a database. The deletion can be automatic, wiping out any files that qualify based upon a certain criteria such as date, or it can be manual, with the user carefully eliminating unwanted files.

data dictionary—A system file that contains the information needed to operate a database in a database management system. A data dictionary includes basic operating information about the records and fields of a certain database, the limits on acceptable data values, and access-authorization information. See **catalog**. See **repository**.

data element—One singular unit of data, also called a data item. A data element is defined by size and type. Size is defined by the number of characters the data element can hold. Type can be defined by several things, such as alphanumeric, numeric only, true/false, etc. A set or range of values also may define the data element. In a spreadsheet, for example, the field ADDRESS would be considered a data element. While data element and data item are used interchangeably in everyday vernacular, there is a subtle distinction: Data elements are the units of data and data items are the singular instances of these data elements. In the example above, the data element is ADDRESS, and "120 West Harvest Drive" might be the data item. The only place this distinction really is made, however, is in database management technical documentation.



data element

data encoding scheme—The manner in which a disk controller records information onto a disk. See **modified frequency modulation (MFM) encoding**. See **run-length limited encoding (RLL encoding)**.

data encryption—The transcription of data into an indecipherable code for security purposes. Encrypted data cannot be viewed or used until it all has been converted into the original form. The government-approved method in the United States is known as the Data Encryption Standard. See **Data Encryption Standard (DES)**.

Data Encryption Standard (DES)—The approved method of performing data encryption in the United States. It was developed by the U.S. National Bureau of Standards and is used by the government and many financial institutions.

data entry—Any action that introduces information to a computer. Data entry can be done through a keyboard, scanner, diskette, online source, or voice recognition.

data field—In a database management system, an area within a data record reserved for a small specific piece of data such as a date.

data file—A file that contains information rather than an executable program. For example, a word processing document is a data file; a word processing program, such as WordPerfect, is an executable program. Also called document file.

data flow—The movement of information through a computer system.

data format—The method of organizing information as determined by an application. For example, a WordPerfect data file must be stored in a format that is compatible with the WordPerfect application.

data frame—In a network system, a data frame is a packet of information transmitted as a single unit. This data frame exists only as it moves along, encapsulated, on the connecting cables or line. The information takes another form before and after the transmission.

data integrity—In a database management system, the level of correctness and consistency of data stored in a collection of files in a database, especially after one file has been affected by a change.

data item—A singular unit of data, also called a data element, typically stored in a field in a database. See **data element**.

data library—An accumulation of cataloged data files.

data link—The connection through which data are transmitted from one component to another.

data link escape—In the ASCII character set, a control key that alters the function of the next character that is pressed.

data management—The process of data organization from input to output. Data management involves hardware, which gathers, moves, and processes the information; software, which dictates what the hardware does with the data; and the user, who must input correct data, select the functions to be performed, and organize data when they are outside the computer. The operating system is the most important element of data management because it combines these three elements into a workable form.

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D

data manipulation—The processing of information. The retrieval, sorting, modifying, filtering, and querying of data are a few of the primary methods of data manipulation. Essentially, data already must be present within a file or database for data manipulation to occur; it does not involve entering new data. The creation or deletion of files, however, is considered part of data manipulation.

data medium—The material on which data are stored, such as a single disk platter in a hard drive or the floppy mylar disk protected by the plastic jacket of a 5.25-inch diskette.

data model—The factors that determine the type of database that will best accommodate and organize a certain set of data. These factors include the type of operations that will be performed on the data and the rules governing the data. Most database management systems will only support one data model. Relational databases and network databases are two of the most popular types of data models. See database.

data modification—In a database management system, any process that updates information.

data network—A network that transmits information with digital, not analog, signals.

data packet—Multiple pieces of data that have been joined together and treated as a single item when passed between network sites.

data processing (DP)—Generally refers to the operations of a computer. It is most commonly used to refer to the manipulation of data to attain specific results in a minicomputer or mainframe computer system.

data processing (DP)—Refers generally to the operations of a computer. Specifically, it refers to the manipulation of data to attain specific results in a miniframe or mainframe computer system.

data protection—Within a computer system, the precautions taken to maintain data integrity and minimize errors.

data rate—See data transfer rate.

data record—In a database management system, a collection of smaller related data fields, such as the pitching and hitting statistics of one professional baseball player, in one data record. One database might contain data records for several baseball players, each comprised of various data fields.

data reduction—The process of compacting data, usually by editing it in some way, organizing it more efficiently, or simply removing irrelevant data. It is not synonymous with data compression. Compare to data compression.

data retrieval—In a database management system, the act of recalling data from a database.

data segment—The part of storage or memory that retains data required by a program.

data set—A collection of related data in a database management system. Used infrequently to refer to a modem.

data set ready (DSR)—A signal emitted by a hardware device to indicate it is ready for use.

data sharing—The mutual use of a single file on more than one computer or by more than one person or organization.

data signal—The form in which information is transmitted within a computer or a network. Data signals usually are binary codes transmitted between devices. Data signals might consist of viewable information, such as documents or graphics, or internal computer information, such as virus checks or control characters.

data sink—Any recording device, such as a hard drive, that can store data. In communications, the term specifically refers to an area within a piece of data terminal equipment, such as a PC, that is able to receive data. See data terminal equipment (DTE).

data source—The author or creator of computer information. In communications, the term specifically refers to an area within a piece of data terminal equipment, such as a PC, that is able to send data. See data terminal equipment (DTE).

data stream—The byte-by-byte movement of data within and among computer systems.

data structure—The way data are organized to be easily retrieved for later use. The efficiency of the data structure often will affect the speed, and thus the quality, of a program.

data switch—Any mechanism that directs data to various locations. For example, a data switch allows a single computer to send data to multiple peripherals, or it allows multiple computers to share a single peripheral.

data terminal equipment (DTE)—In communications, a hardware component connected to some type of communications device. A PC is a piece of data terminal equipment; a modem is a communications device.

data terminal ready (DTR)—A hardware signal indicating a computer is ready to receive an incoming transmission.

data transfer—Any transmission of information within a computer system or between a computer and a peripheral.

data transfer rate—The speed at which a disk drive can transfer data from the drive to the processor. The rate usually is measured in megabits or megabytes per second.

data transmission—The exchange of information within a computer or among computers.

data type—The kind of information used in any application or stored in any file. Some examples are alphanumeric, numeric, and logical (true or false). The data type, which cannot be changed after it has been set, determines how and in which kind of

operations the data can be used. In programming, data type refers to the range of values that can be assigned to a variable. See alphanumeric. See numeric. See logical.

data underrun—The inability of a computer to keep up with the recording or playback process. When writing to CD-Recordable (CD-R) discs, data underruns can cause serious problems, since the discs must be written in a continuous stream of information that cannot be interrupted. Underruns also can occur during playback, especially with large, CPU-intensive files such as digital movie files. If the computer can't read the movie from the hard drive or CD-ROM fast enough, there may be gaps or short stops in the movie.

data validation—The act of checking data to determine if they are current, consistent, and accurate.

data value—The meaning of a piece of information—either an item or a variable type.

data warehousing—A method of storing, managing, and cataloging large relational databases. These databases are stored either on mainframes, minicomputers, or multiple local-area network (LAN) relational database servers. Based upon the client/server model, the goal is to provide users with timely and accurate information for decision making. Early data warehouse efforts used IBM's DB2 mainframe relational database. Unix-based data warehouses have been created. Similar terms include "data malls" and "data marts." The latter term refers to data warehouses created with LAN-based relational database management systems. See client/server network.

data word—The uniform unit of data storage within a computer. The quantity can vary depending on the microprocessor, but generally a word is 16 bits, or two bytes. A 32-bit data word is called a double word.

data-interchange format (DIF)—A standard method of organizing information in a database so it can be easily transferred to a similar program.

database (DB)—A collection of related information in an easily accessible format such as a table, form, or report. Databases can contain anything from address lists to PBA bowling schedules. There are two types: flat-file databases, which work with only one table at a time, and relational databases, which can work with two or more tables simultaneously. Databases are composed of rows and columns, otherwise known as records and fields. A field is one piece of information composed of smaller bits of data such as one person's name, address, and age. A record, on the other hand, is a group of fields such as a collection of customer records. Databases can be used to sort data, compare data, and manipulate data in many other ways. See database management system (DBMS). See data field. See data record.

database administrator (DBA)—The individual responsible for the database in a network system.

database engine—A set of routines, commands, and data structures that allows communication to occur between a database and its program language.

database machine—A hardware component that executes database computations and operations only, thus relieving the main computer of the task.

database management system (DBMS)—A program that arranges, secures, and retrieves the information in a computerized database. A database management system controls the contents of a database, allowing for the transfer of data within a computer system, as well as the formatting of data for printing.

database model—The method of organization within a database system. Most databases are arranged in two dimensional tables of rows and columns. Relational databases allow data to exist on more than one such table simultaneously. The opposite of a relational database is the flat-file database, which uses only one table at a time. Databases might also have three dimensions, with x, y, and z coordinates describing each data item. See relational database. See flat-file database.

database server—A computer with a database that is accessible by other computers on a network. The database server also processes database requests. If the database server only performs certain processing functions, it is known as a database machine. See server.

DATACOM—See data communication (DATACOM).

datagram—A single unit of data, including its destination information, which is transmitted through a network.

data integrity—In a database management system, the level of correctness and consistency of data stored in a collection of files in a database, especially after one file has been affected by a change.

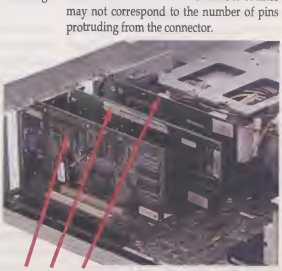
daughterboard—A printed circuit board attached to another board, usually the motherboard, giving a computer additional capabilities. Also called a daughtercard or an expansion card. See expansion card.

daughtercard—See daughterboard.

dB—See decibel.

DB—See database.

DB connector—A type of cable connector for a parallel or serial port. Typical DB (Data Bus) connectors are the DB-9, DB-15, DB-19, DB-25, DB-37, and DB-50. The number that follows the DB indicates how many active lines the connector has. The number of lines may not correspond to the number of pins protruding from the connector.



DBA—See database administrator (DBA).

dBASE—A flat-file database management system created by IBM that has become an industry standard primarily because it was the first comprehensive database system.

DBMS—See database management system (DBMS).

D

DC—See direct current (DC).

DCD—See data carrier detected (DCD).

DCE—See data communications equipment (DCE).

DDBMS—See distributed database management system (DDBMS).

DDE—See dynamic data exchange (DDE).

DDR-SDRAM—Short for Double-Data-Rate Synchronous Dynamic random-access memory, also known as SDRAM II. See Synchronous Dynamic random-access memory (SDRAM).

de facto standard—A widely accepted computer application, language, or design that has become an industry standard but is not yet officially recognized as such.

dead halt—A sudden and uninitiated failure of the computer system that prevents any command from being completed. A dead halt will continue to show the last usable screen on the monitor until the computer is rebooted, either by pressing the CTRL-ALT-DEL key combination or by turning the computer off and then on again. Any information that was unsaved at the moment of the dead halt will be lost. Also called drop-dead halt. See **boot**. See CTRL-ALT-DEL key combination.

dead key—A key that has no function when pressed by itself but produces an effect when pressed in conjunction with another key or keys. One example is the SHIFT key.

dead-letter office—In electronic communications, a centralized virtual mailbox that contains misaddressed and other undeliverable pieces of electronic mail.

deadlock—An error that occurs when two programs are each waiting for a signal from the other to proceed. Also called deadly embrace.

deadly embrace—See deadlock.

deallocate—To release or disengage memory that already is allocated to a program or user. The user or the application may choose when to deallocate memory. Other computer resources, such as peripheral devices, also can be deallocated. Deallocating a device or memory location frees it for other applications or users to use.

debugger—A program that locates the errors (bugs) in a program by proceeding slowly through the program, carefully checking the data structures and the program logic. A debugger verifies and validates a program for proper execution, placement of keywords, system and application parameters, and variable content. Some debuggers are relatively simple; others are more complex and may check spelling, performance, duplication, and unused or undeclared variables. Debuggers are tailored to a specific authoring language and most often are part of an authoring system.

debugging—The process of ridding a program of the logical or syntactical errors that occur in programming. See **debugger**.

decay—The gradual decrease of a signal's amplitude for any reason.

deceleration time—The time it takes the access arm of a disk drive to slow down as it moves across a disk to retrieve a piece of data. The weight of the access arm picks up momentum as the access arm moves, and the arm must slow down before stopping. Data storage devices are extremely fragile—the density of data stored on a disk being a primary reason—and all pieces of these components must be programmed to be precise in their operations. An access arm that is off by even a fraction of a millimeter can cause serious data storage problems. See **access arm**.

decentralized processing—A computing system that shares responsibilities with other processors within the computer or network. The duties do not have to be evenly shared, nor do they have to be arranged to work synchronously.

decibel (dB)—One tenth of a bel, a unit of sound measurement.

decimal—The base-10 numbering system comprised of the numerals 0 to 9. Although people commonly use the decimal system to express numbers, most computers use the binary, or base-2 system. Compare to **binary**. Compare to **octal**. Compare to **hexadecimal numbering system**.

decision box—A diamond-shaped box in a flowchart that denotes a decision to be made. For example, when a user chooses to delete an item, the program might request verification before completing the process. This request would be represented as a diamond in a flowchart and would continue the process of deleting information if a "Yes" answer were given and discard the process if a "No" answer were given. Programmers sometimes use flowchart diagrams to outline the proposed structure of an application as they write its programming code. See **flowchart**.

deck—A storage device, as in a tape deck.

declaration—A statement or performance that fixes the value of a piece of data for use in a program. For example, the declaration "RED=FF0000" establishes the value for "RED" so later in the program, the statement "SET COLOR TO RED" is understood by the program. Declarations most often are found in a program's source code, which is the part of the programming code that is readable by humans. Declarations primarily are used when a value is needed in several places throughout a program.

decode—One of the four steps in the CPU machine cycle. After the CPU is given a machine language instruction, it must be decoded into a form the CPU can understand. See **execute**. See **fetch**. See **store**.

decoder—Any component or application that converts coded text into readable form or translates one language system into another.

decompiler—An application that translates a programming language understood by

humans into a high-level code understood by a computer.

decompression—The process of restoring compressed data to their original form. This task must be accomplished with a program that recognizes the format of the compressed file. See **file compression**.

decryption—The process of translating encrypted data back into their original language.

dedicated channel—A communications line, usually of a permanent or long-term nature, that is devoted to one purpose. Dedicated lines also allow for continuous, uninterrupted transmission. For example, many Web servers are connected to the Internet through a dedicated channel so any Internet user can access the data contained on the server at any time. Dedicated channels can be owned or leased, usually by the month or year. Also called dedicated line. Compare to **dial up**.

dedicated line—See **dedicated channel**.

dedicated server—See **server**.

Deep Computing—The use of extremely powerful computers, software, and advanced algorithms to perform tasks previously beyond computing's reach, such as solving complex problems or gleaning information from extraordinarily vast amounts of data. Researchers are using Deep Computing to help develop new drugs, significantly reducing the time required for design. Meteorologists are using it to develop more complex weather models that could lead to a better understanding of weather phenomenon and improved forecast reliability. Other uses include research in financial markets, biomedicine, and simulations that let weapons experts certify the safety and reliability of nuclear weapons without live tests.

default—The standard setting, predetermined by your computer, that is engaged when the user fails to denote a specific alternative. Defaults generally are the most often used settings for a particular program.

default button—In a graphical user interface, a button that has been predetermined to be the most often used option or command. For example, in Windows, the default button often is the OK button.

default drive—The disk drive that is automatically employed by an operating system, unless denoted otherwise, when a computer is booted.

default font—The font normally used when text is displayed on a computer with a graphical user interface.

default printer—The printer to which the computer automatically sends documents to be printed.

Defense Advanced Research Projects Agency (DARPA)—A U.S. Department of Defense research agency responsible for exploring and funding technological possibilities such as artificial intelligence and robotics. This agency is now known as ARPA because it has begun to investigate and endow non-defense research. ARPA is well-known for its work in setting up the Internet. See **Advanced Research Projects Agency (ARPA)**.

deferred address—An area in memory that remains unaffected by system activity until an application specifically calls for it.

deferred processing—The act of processing information after it has been in the computer system for some time. Compare to **direct processing**.

defragger—See **defragmenter**.

defragmentation—The act of reorganizing a hard disk or diskette so individual applications or files aren't fragmented, or scattered. This fragmentation occurs because of the way information is stored in little pieces on a disk. As more information is stored, it becomes divided into tiny particles, so data for one application or file can be found in many places on the disk. Defragmentation usually involves rewriting programs into contiguous clusters. The process speeds a program's loading and retrieval time because the read/write head doesn't need to search for scattered pieces. It also eliminates the small unused areas left behind when pieces of information are deleted, which in turn allows the disk to store a maximum amount of information. Defragmentation can be done with a disk optimizer such as a defragmenter. See **file fragmentation**.

defragmenter—A disk optimizer that efficiently organizes and rewrites the scattered parts of a file into adjacent sectors on a disk so it can store a maximum amount of information. The DEFRAG utility in DOS 6.x is one example. Also called defragger. See **defragmentation**.

degausser—A demagnetizing device often used to erase data from the read/write heads of magnetic storage devices.

degradation—The deterioration of a communications signal for any reason.

dejagging—See **anti-aliasing**.

delay distortion—See **envelope delay**.

delete—A command used to remove data from a storage medium. Although the files might not appear on the computer screen, deleted files are not actually erased or removed from the storage medium. Rather, storage space containing the deleted files is designated as available for storing new data. The new data then overwrite the deleted data. Because the deleted data remain on the storage medium until new data replace them, it may be possible to recover all or part of a deleted file. See **erase**. See **undelete**.

DELETE key—The keyboard key used to erase individual characters to the right of the cursor or highlighted strings of characters.

demo disk—A diskette or CD that contains a demonstration program. Demo disks usually are distributed by the manufacturer.

demodulation—The process of interpreting the variations of a modulated carrier signal into digital transmissions. A modulated carrier is an analog wave such as a sound wave. Tiny variations in a sound wave's depth, height, or frequency become the changes in sound our ears hear and our brains interpret. However, for computers

to decipher sound, the analog waves must be translated into digital code. Modems (the term is short for modulation-demodulation) are common devices used to transfer digital information from a computer to analog phone lines and vice versa. See **modem**. See **modulate**.

D

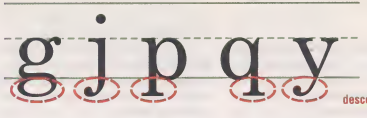
demonstration program—A model that offers a limited preview of an application currently in development. Demonstration programs, which usually are distributed by the manufacturer for free or at a low price, differ from beta and alpha programs in that a demonstration program isn't an entire version of the program. Also, demonstration programs are distributed for marketing purposes rather than for quality-control purposes. Compare to **alpha version**. Compare to **beta version**. Compare to **prototype**.

denial of service attack (DoS)—An attack on a network computer designed to render it unusable by flooding it with network traffic. These can take the form of attacks on a single computer or entire Internet service providers (ISP). An ISP can be brought down by a DoS attack if the attacked computer is vital, such as a server that handles inbound and outbound E-mail messages or the ISP's Web server. DoS attacks work by flooding a computer with bogus requests. An example of such an attack would be if a computer sent thousands of ping requests (which normally are used to analyze the viability of a network connection) per minute. The affected computer will use all its resources trying to answer the flood of ping requests, which will either cause it to crash or run so slow that it becomes unusable. Crackers responsible for a DoS attack often spoof a legitimate account or forge the headers of the data packets to hide their identities. See **packet**. See **ping**.

dependence—The reliance of one program, operation, or device upon another for its function.

dependent variable—A character that relies upon a previous operation to determine its value.

dereference—In programming, to retrieve information from an address retained by a pointer. The pointer is a variable that does not indicate the data, just the location of the data. Different computer languages use different syntax for dereferencing. See **pointer**.



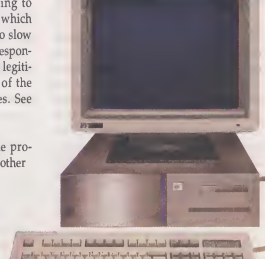
derived font—A specialized font that has been created from a standard font.

DES—See **Data Encryption Standard (DES)**.

descender—The part of a lowercase letter that falls below the baseline. Lowercase g, j, p, q, and y all have descenders. No capital letters have descenders. The lowercase letters b, d, f, h, k, l, and t all have ascenders. Compare to ascender.

descending sort—A method of arranging data in reverse alphabetic, numeric, or date order. Examples include a numerical sort from 10 to one and an alphabetical sort from Z to A.

desktop computer



deserialize—To convert a serial data string, which is organized bit by bit, into a parallel data string, which is arranged byte by byte. See **bit**. See **byte**.

design cycle—The process of creating new hardware and software from conceptual development to final release.

Desktop—Refers to the Windows 95 or Windows 98 Desktop, the first screen you see when either OS is opened. The Desktop always includes at least four items: the My Computer icon, the Recycle Bin, the Start button, and the Taskbar.

desktop—In a graphical user interface (GUI), a system of organizing icons on the computer screen that employs the same principles used for organizing the top of a desk. Items on the desktop can be moved among folders and directories with relative ease. Desktop also is short for desktop computer. See **desktop computer**. See **desktop level**.

desktop computer—A computer that fits on or under a desk or table, as opposed to a mainframe or miniframe computer that requires floor and room space, or a laptop computer that fits in a briefcase. The IBM PC made the desktop computer popular. Desktop computers usually are smart terminals with the ability to run a variety of programs on their own. Compare to **dumb terminal**.

desktop level—In a graphical user interface (GUI), the screen from which all applications can be accessed. The desktop level usually is the screen that first appears after you log on to the computer.

desktop model computer—See **desktop computer**.

desktop publishing (DTP)—The use of a computer to produce documents for publication. Desktop publishing software

packages range from simple programs that let a user create black-and-white newsletters to elaborate hardware and software setups that can produce multicolored magazines. Desktop publishing documents usually include text as well as graphical elements arranged in an eye-pleasing way. Desktop publishing software has helped revolutionize the publishing world by letting small companies and individuals produce professional-looking designs without hiring a printer.

desktop

desktop video—The hardware and software that control the multimedia video displays on your desktop computer. A video card and a viewing application are two necessary components.

destination—The site to which data are directed. A site can be any hard drive, diskette, file, directory, or document within the computer or online.

destructive readout (DRO)—A process that automatically erases data as they pass from the memory to the CPU. The computer must then rewrite the data to memory. Destructive readout primarily occurs in core systems, which use a type of memory popular before RAM became widely used and affordable. See **core**.

developer—See **application developer**.

device—An external hardware apparatus that attaches to a computer to allow it to send or receive a specific type of data. A printer and a modem are two examples.

device address—A memory site within a computer's RAM address space from which a computer component can read data and to which the component can send data en route to the CPU. The data stored in the device address can be changed by either the CPU or an external device, which makes it unlike other locations that can only be altered by the CPU.

device driver—A program that allows a hardware peripheral, known as a device, to communicate with a computer. Some device drivers, such as those for the monitor and keyboard, usually come with the computer, while others, such as those for a CD-ROM drive or a sound card, come packaged with their corresponding device. Device drivers, as well as updates for the device drivers, also can be obtained from the manufacturer of the component.

device independent bit map (DIB)—A format that allows bit-mapped graphics to be viewed using different display applications. See **bit map**.

device name—The identifying name an operating system assigns to a component. For example, the first parallel port is known as LPT1, while the first communications port is called COM1.

device-dependent—A program that requires a specific hardware component to operate. An application that prints only to a plotter is device-dependent.

device-independent—A program that does not require a specific hardware component to operate. For example, an application that allows a document to be printed or sent by electronic mail (E-mail) or fax.

DIA—See **document interchange architecture**.

diacritical mark—A mark indicating accent, located above, below, or through an alphanumeric character, such as the letter e in the word résumé.

Résumé

diacritical mark

diagnostic program—A program that compiles technical information about computer hardware and peripherals and then produces a report that can be used to diagnose technical problems. Most diagnostic programs make a record of the normal operating settings of a computer. When a problem occurs, the program produces a new report, and the problem usually can be diagnosed by finding a discrepancy between the two reports.

dial up—To establish a temporary connection with a network or another computer using a modem connected to a telephone line. Dial-up access usually requires software, such as Trumpet Winsock, in addition to the modem and phone line. Dial-up connections are usually billed at a flat monthly rate, but some services use per-hour charges. Compare to **dedicated channel**. See **dial-up networking**.

dial-up networking (DUN)—A built-in feature of Windows 95 that lets a computer connect to a network via a modem. It usually uses either the Point-to-Point Protocol (PPP) or Serial Line Internet protocol (SLIP) to control the traffic between the computer and remote network. Windows 3.1 did not offer built-in DUN support. Instead, users had to obtain dial-up software such as Trumpet Winsock. Dial-up networking is almost exclusively used for connecting PCs to the Internet. See **dial-up**. See **Point-to-Point Protocol**. See **Serial Line Internet Protocol**.

dialect—A variation of a prominent computer language. Several prominent programming languages have such offshoots. Turbo Pascal, for example, is a dialect of Pascal.

dialog—The exchange of information between a person and a computer, usually consisting of commands and responses.

dialog box—In a graphical user interface (GUI), an on-screen text box that provides users with information and explains possible options. For example, a dialog box for a wizard in a word processing program might provide choices between creating a fax cover sheet or a business letter. After the user clicks an option, the dialog box would present another set of options, such as a list of formatting styles. Dialog boxes filled with options would continue to appear until the document is created.

DIB—See device independent bit map.

dibit—(Pronounced dye-bit.) The combination of the two binary digits into one of four combinations: 1,0; 1,1; 0,1; and 0,0.

DIF—See data-interchange format.

difference engine—A conceptual, although never completed, 19th-century computer developed by Charles Babbage that would have allowed for mechanized mathematical subtraction.

differential—A circuit that distinguishes between two signals rather than between a single signal and a benchmark voltage. See benchmark.

digit—A character in a numeric system.

digital—An electronic device that uses a limited, predetermined numbering system to measure or represent the flow of data. Modern computers are digital because they use the fixed binary digits 0 and 1 to represent all data. In contrast, analog is an electronic device that uses a system of unlimited variables to measure or represent the flow of data. Radios are analog because they use variable sound waves to carry the data from the transmitter to the receiver.

digital audio extraction (DAE)—A feature on CD-ROM drives that lets them pass data from audio CDs through the computer buses (i.e., IDE or SCSI) like any other CD-ROM data, instead of converting it to an analog signal sent to the sound card. This feature is especially useful for copying CDs. Without digital audio extraction, CD audio is converted to analog then converted back to digital when written to the blank CD. The multiple conversions degrade the sound quality, so performing a straight digital transfer is desirable for the best sound quality. This feature is relatively new, so older CD-ROM drives may not support it.

digital audio tape (DAT)—A portable cassette that holds information recorded on magnetized tape in digital rather than in analog form. With their capability of storing 1GB of information, DATs are used to back up large computer systems. Because information can only be retrieved sequentially, however, DATs are too slow for normal operating purposes and are best left to archival storage. Also called DAT cartridge.

digital audio tape (DAT) drive—The mechanism used to transmit data to and read data from a DAT.

digital camera—A camera that records still or moving images as bits in a computer file. Digital images can be loaded directly into computer programs and reproduced an infinite number of times without losing image quality.

digital communication—A form of data exchange in which all information is transmitted in digital form, as opposed to analog form. See analog. See digital.

digital data transmission—A method of sending and receiving data using a binary code of on (1) and off (0) signals.

digital display—See digital monitor.

digital joystick—A joystick that transmits information to the computer via a digital signal (a series of zeros and ones). In contrast to analog joysticks, which use a specific voltage to tell the computer the joystick position, digital joysticks use a specific binary number to tell the computer the joystick position. Digital joysticks require less work from a central processing unit (CPU) and can support more buttons. See analog. See analog joystick. See data compression. See digital.

digital joystick

digital line—A data transmission line that carries only digital binary code for reception and emission. The opposite of a digital line is an analog line, which communicates information such as sound waves in analog form. Standard phone lines are a good example of analog lines. In practical terms, the main advantage of digital lines over analog lines is reliability. For signals to travel a great distance, they must be amplified periodically along the way. Analog transmissions, when amplified, build up interference. Users might hear this interference as hissing or crackle in older long-distance phone lines. Digital information, when amplified, picks up no such distortion. This makes digital lines ideal for today's improved long-distance lines. See digital. See analog.

digital monitor—A video display such as a monochrome or Enhanced Graphics Array (EGA) monitor that presents images in shades of gray or limited colors. Unlike analog monitors, digital monitors are not capable of displaying an unlimited range of colors. Compare to analog monitor.

digital phone line—A phone line that uses a digital signal to carry voice and data communications. By transmitting audio and data digitally, the information is translated into a binary code of ones and zeros. This method allows for faster communication and greater reliability than the analog method, which converts sound waves into an electronic signal deciphered by measuring changes in frequency and modulation. Digital signals can be amplified without distortion, unlike analog signals, for which noise is amplified along with the signal. The U.S. telephone signal is almost entirely digital except for the portion from the local telephone exchange to a residence. Digital phone lines bridge that last gap and provide a digital line and cleaner connection to the exchange. Digital lines also can carry voice and data calls simultaneously across separate channels, as with Integrated Services Digital

Network. See **analog phone line**. See **Integrated Services Digital Network**. See **throughput**.

digital photography—A process that records images as bits of information in a computer file rather than on photographic film. Images recorded digitally can be imported directly into graphics programs, desktop publishing programs, or even databases and word processors.

digital recording—The act of storing data in a binary code (1s and 0s). Most disk drives use digital recording to store information.

digital signal—A transmission current in which the information is perceived as a string of impulses, as in the binary system of 1 (on) and 0 (off).

digital signal processing—Converting analog signals into digital ones. The most common use of digital signal processing is for filtering out noise or other interference from data, audio, or video transmissions by converting the signal to digital form, running that digital signal through noise-reducing algorithms, and then converting the signal back into analog form. Filtering noise out of digital signals is easier because the signal can be more easily isolated from the noise. Digital signal processing is also used as a data compression technique because carrying digital signals requires less bandwidth than carrying analog signals. Common technologies that use digital compression include 56 kilobits per second (Kbps) modems and Integrated Services Digital Network (ISDN) technology.

digital signal processor (DSP)—A special circuit created to allow high-speed data transmission and manipulation, particularly in communications and graphics-intensive and audio-intensive applications.

digital signature—A method of data encryption used to verify the identity of an individual transmitting information over the Internet. A digital signature, like a handwritten signature, is unique to a specific computer or user. One form of digital signature involves using a public/private key system. Information protected this way is encrypted using a pair of codes, or keys. The public key is available to the public; the private key is known only by the individual user. The sender encrypts the data with the public key of the intended recipient. Only the intended recipient, with the private key that corresponds to the public key, may access the transmitted data. Digital signatures also might be attached to data without encryption but with a mathematical value that changes if the information is altered in any way. This allows readers to determine if the document has been altered since it was signed. Digital signatures can be as legally binding as their pen-and-paper equivalents if the parties involved agree to their use. See **encrypt**.

digital simultaneous voice and data (DSVD)—A type of modem that allows for the simultaneous transmission of digital computer data (such as graphics, programming commands, and text) and digitized voice data over telephone lines. Both the sender and receiver must have a DSVD modem; otherwise, the DSVD modem operates just as any other modem. Most DSVD modems transmit data at a rate of 28.8Kbps: 19.2Kbps for data transmission, 9.6Kbps for voice transmission. The modems not only allow two people to, for example, play a computer game together, but also let the players talk to each other over the same phone line to which the modems are connected. DSVD modems are increasingly used as part of manufacturer support systems because they let technicians download diagnostic information from user computers over phone lines while carrying on a conversation with the user.

digital sort—A separation process that divides and arranges digital information.

Digital Subscriber Line (DSL)—Technology used to transmit digital data on regular copper phone lines. DSLs can be used to provide connections to the Internet or local-area networks (LANs) or for videoconferencing. The technology differs from Integrated Services Digital Network (ISDN) lines in that it can send analog and digital signals over the phone line. ISDN is digital only and has to convert analog voice phone calls to digital signals. With DSL, the analog voice phone calls and digital signals can coexist on the same wires. This works because analog signals require only a fraction of the capacity of the copper wires that make up a phone line. The limitation of the analog signal carried on those wires, not the wires, has kept phone lines from delivering greater data transfer speeds. Sending digital signals over copper wires breaks that barrier. See **Asymmetric Digital Subscriber Line**. See **Integrated Services Digital Network**. See **xDSL**.

digital-to-analog converter (DAC)—A device that converts digital data into an analog signal. CD players contain digital-to-analog converters that transform the digital signal on the CD into analog signals that can produce sounds. Also called a D-A converter.

DVD

digital versatile discs—See **Digital Video Discs**.

Digital Video Discs (DVD)—CD-ROM-like discs that can store massive amounts of data in digital form—133 minutes of high-resolution, wide-screen video or 4.7 gigabytes (GB) of data on each side of the disc. These discs eventually may replace regular CD-ROMs as well as VHS videotape and laser discs. Also known as digital versatile discs.

digital video express (Divx)—A digital video disc (DVD) format, which was discontinued in June 1999. Divx video discs were time-restricted (playable only for a certain number of days) or use-restricted (playable only for a certain number of times). This format was convenient for users since the discs didn't have to be returned. If users wanted to watch a movie more than the allotted number of times or days, the Divx player came with a modem that dialed into a remote computer to upgrade the copy of the movie for a fee. The format was not backward-compatible with older DVD players. See **Digital Video Discs**.

digital video interactive (DVI)—A technique developed by RCA, Intel Corp., and

GTE that allows for the compressed storage of full-motion video data on a CD-ROM.

digitize—The process of converting linear pictorial images into digital data for storage. For example, a scanner converts a non-digital image, such as a portrait or photograph, into a digital format of positively (1) and negatively (0) charged signals so the image can be stored on a hard drive. Likewise, a sound card can digitize a sound by translating it from analog (its actual sound) to digital (a form that can be read by a computer).

digitized speech—Speech that is converted from fluctuating analog sound waves to digital data binary code for storage on a computer.

digitizer—See graphics tablet.

digitizing tablet—See graphics tablet.

DIMM—See dual in-line memory module.

dimmed command—A command in a graphical user interface (GUI) that is gray or shaded, rather than distinct and vibrant, to indicate it is unavailable for use. Dimmed commands cannot be used until some other operation has been performed.

dingbat—See Zapf dingbats.

diode—Any device or circuit that allows electrical currents to travel in one direction only.

DIP—See dual in-line package.

DIP switch

DIP switch—A tiny switch located on the casing of dual in-line packages, which encased integrated circuits on older computers. Each switch, which works like a miniature light switch, turns on or off a certain option on a circuit board. DIP switches usually are found in a row with other DIP switches. See dual in-line package.

DirecPC—An Internet connection provided through a satellite dish that offers speeds of up to 400 kilobits per second (Kbps) downstream (data flowing in). The dish provides no upstream connection, so users still must have a regular modem and phone line for sending requests to the 'Net.

direct access—The ability of a computer to locate and retrieve data immediately from a storage device, without having to start at the beginning and read all the data until the appropriate information is found. Also called random access. One example of a direct access device is a disk drive. The computer does not have to read through many files on a disk to find the file it needs but rather goes directly to that file.

direct-access modem—See direct-connect modem.

direct access storage device (DASD)—(Pronounced DAZZ-dee.) A storage device that can access any piece of data directly without having to read the preceding data. A CD-ROM drive is a direct access storage device.

direct address—In programming, the exact location of data in a computer's memory. Conversely, an indirect or relative address determines the location of data in a computer's memory by relating the data's position to another point. A direct address is like a specific street address, such as 123 Central Ave.; an indirect address, on the other hand, is directions to a certain location, such as "the fourth house from the corner." Also called absolute address or real address. Compare to indirect address.

direct-connect modem—A modem that connects directly to a phone jack rather than an intermediary device such as an acoustic coupler.

direct current (DC)—An electrical current that flows in one direction. For example, batteries use direct current. Compare to alternating current.

direct memory access (DMA)—A means of transferring data from a storage device, such as a hard drive or a tape drive, to memory without passing the information through the processor.

direct processing—The act of processing information as it is entered in the computer system. Compare to deferred processing.

direct read after write (DRAW)—A correcting technique that monitors data being recorded onto an optical disc. The recorded information is immediately compared to the original. If a mistake is discovered, the correct information is stored at a new location until the recording process is completed. Then the correct information replaces the errors.

direct read during write (DRDW)—A correcting technique that monitors data while it is being recorded onto an optical disc. The recorded information is immediately compared to the original. If a mistake is discovered, the recording process stops and the correction is made immediately.

direct view storage tube (DVST)—A type of cathode-ray tube (CRT) that allows an image to be viewed on a monitor for an indefinite period without need for refreshing. After the image has been projected on the monitor, however, it cannot be manipulated unless it is erased.

direction keys—See cursor keys.

directory—An organized catalog of files and subdirectories contained on a hard drive or a removable disk. The main directory is called the root directory; all subdirectories stem from it. Directories are found in the hierarchical file schemes common to most operating systems, including Windows 95, DOS, and OS/2. Such file systems store data as if in a file cabinet. The root directory is the file drawer, subdirectories are the folders in that drawer, and individual documents are files in those folders. File names can be organized within a directory in many ways, such as alphabetically, and by type, size, or date. In graphical interfaces such as Windows 95, folders can be displayed as icons. See child. See parent/child.

directory path—See access path.

directory sorting—A list of the files contained in a directory that are separated and arranged according to name, file type, date of creation, or file size.

directory tree—A diagram of a disk's root directory and all the subdirectories and files that extend from it.

dirty ROM—In early models of Macintosh computers, a portion of ROM used by the programmers and engineers and placed off-limits to end users. Macs have always had internal 32-bit addressing capabilities, but the first Macs could use only 24 of the bits. So programmers and engineers used the last eight bits of the 32 bits for their own programming purposes. As memory became more important to the computer and it became possible to use full 32-bit addressing, this portion of ROM in newer model Macs was made available to the end user. These newer Macs, with full 32-bit addressing capabilities have "clean ROM." Older Macs, which still use only 24 bits of the 32-bit addressing, have dirty ROM.

disable—To turn off a function or prevent an event from occurring. In hardware, disable usually means to unplug or remove a component.

disassembler—A program that converts machine language into the assembly language that can be understood by human beings. See **assembly language**. See **machine language**.

disaster dump—The transfer of data to an output component, such as a printer, as a desperate attempt to at least partially recover information that has fallen victim to a disk error or failure.

disc—An optical data storage device that is round, flat, and rigid. A laser writes data to and reads data from the hard plastic outer layer of the disc. Until recently, end users could only read from this type of storage, but advances have led to hardware devices enabling users to write to discs as well. CDs (audio and CD-ROMs) are the most popular form of disc now in use; although, Digital Video Discs (DVD) are becoming increasingly popular. See **CD**. See **CD-ROM**. See **Digital Video Discs**. Compare to **disk**.

disc-at-once—A method for writing data to a CD-R disc that writes the entire disc at once. Information to be written to the disc is staged, a table of contents is created and placed at the beginning of the disc (also known as the lead-in section), and the information then is written in one continuous stream. The recording laser doesn't shut off until all the information has been written. A lead-out section of 1.5 minutes of silence is appended to mark the end of the CD. This method is inefficient when it comes to data storage except when creating copies of CD-ROMs from a master. It is also a poor method if data will have to be added to the CD-ROM later, because once CD-ROMs have been written in the disc-at-once method, they can not be written to again. Disc-at-once is superior, however, for recording audio CDs because it lets users specify the length of gaps between songs. Compare to **track-at-once**.

discrete component—A hardware device considered a separate and distinct entity.

disk—A round flat magnetic data storage device that can be rigid (hard) or flexible (floppy). A magnetized device contained within a hard or diskette drive records and reads the information. A hard drive is the primary permanent storage device in most PCs, while a diskette is the primary portable storage device. The term disk most often refers to the disk within a hard drive, but it also can refer to a rigid or flexible diskette storage device. See **disk drive**. Compare to **disc**.

disk access time—The length of time required for a computer system to process a data request from a microprocessor and then retrieve data from a storage device such as a diskette drive or a hard drive. See **access time**.

disk buffer—A memory zone that temporarily stores data that have just been read from or are about to be recorded to a disk. The disparity in speed between a disk drive and the CPU necessitates a disk buffer for a more efficient data read/write process.

disk cache—(Pronounced disk cash.) A reserved portion of memory that acts as a buffer between the CPU and a disk. A disk cache may significantly speed data retrieval. When a program requests data, it first passes through the disk cache on its way to the storage device. If the requested information has been used recently, the program may quickly locate and retrieve the data from the disk cache rather than waste time searching the hard disk.

disk capacity—The number of bytes, or characters, a disk can hold; the maximum storage volume of a disk. Capacities are usually stated in kilobytes (KB or K), megabytes (MB), or gigabytes (GB).

disk cartridge—A portable hard drive, similar to a diskette, that allows large amounts of stored data to be transported among computers.

disk cartridge

disk controller—The printed circuitry that governs the operations of diskettes and hard drives. A disk controller can be found as an expansion card that plugs into an expansion bus, or it might be contained in the hard drive, such as in an IDE drive.

disk copy—The process of putting information from one disk onto another so the information exists in more than one place. Usually the term is used when one is copying the entire contents of one diskette to another. The DOS DISKCOPY command performs this function.

disk crash—The unexpected failure of a diskette or hard drive.

disk density—A relative measurement of the amount of data a diskette can hold. High-density diskettes can hold more information than low-density diskettes.

disk directory—A catalog of the files contained on a single diskette or hard disk.

disk drive—A peripheral storage device containing a disk or disks onto which data can be stored and retrieved. Diskette drives, usually referred to as the A: drive, have the smallest storage capacity and are the slowest. Hard drives, usually called the C: drive, are self-contained drives that have large storage capacities and fast data recall times. CD-ROM drives, often called the D: drive, can be either externally or internally and are often used to run entertainment and educational programs. See **disc**. See **disk**. See **diskette**.

disk driver—A device driver, distributed by the manufacturer, that allows a specific disk drive to communicate with the rest of the computer system.

disk duplexing—A networking technique that writes information to two hard disks simultaneously using two disk controllers. If one of them fails, the functioning system can continue operations. Disk duplexing, however, should not be considered a substitute for disk backup. Also called disk mirroring.

disk envelope—The protective paper sheath in which a 5.25-inch diskette and its attached jacket are stored when not in use. Compare to **disk jacket**.

disk interface—Circuitry that links a diskette or hard drive to a computer.

disk jacket—The protective plastic sheath in which a 5.25-inch diskette is stored. Compare to **disk envelope**.

disk mirroring—See **disk duplexing**.

Disk Operating System (DOS)—(Pronounced doss.) Generally, any computer operating system that must be retrieved from a disk drive when the computer is booted. Specifically, DOS is an operating system sold primarily by Microsoft Corp. and IBM. In the 1980s, IBM hired Bill Gates to create an operating system for a new line of PCs. Gates and his fledgling company purchased the rights to a simple operating system manufactured by Seattle Computer Products. Gates used this operating system as a template for the operating system he would produce for IBM. In a decision that has had monumental repercussions in the computer industry, IBM

disk drive

then chose to market the operating system under its own name while allowing this company, known as Microsoft, to retain the rights to the operating system's code and market the operating system under its own name, too. Soon, these new operating systems, MS-DOS and PC DOS, had become the most popular operating systems. In 1990, Digital Research (later purchased by Novell) created a version of DOS known as DR-DOS. In 1993, IBM replaced PC DOS with IBM DOS. Regardless of these changes, graphical user interfaces, such as Windows, are the operating systems of the present and future. DR-DOS is already a thing of the past, and MS-DOS and IBM DOS are succumbing to the Windows phenomenon. DOS is used to manage and maintain storage media, such as disk drives, and the files stored therein. See **DR-DOS**. See **IBM DOS**. See **MS-DOS**. See **PC DOS**.

disk optimizer—A program that organizes the data and programs on a disk so they can be stored with greatest efficiency, thus allowing the disk to contain the maximum amount of information possible. As more information is stored to a hard drive, it becomes divided and partitioned into tiny particles, so the data for one application may be found in many places on the hard drive. A disk optimizer rewrites the data to contiguous sections of a hard drive, which in turn eliminates the small unused areas left behind when files and parts of applications are deleted. Disk optimization also speeds up the reading of information from the disk. A defragmenter is an example of a disk optimizer. See **defragmenter**.

disk pack—A portable storage device, primarily found in mainframe and miniframe computers, which consists of a stack of hard drives and a protective plastic container.

disk partition—A portion of a disk capable of containing a set amount of data. See **disk partition table**.

disk partition table—A permanent data structure that describes how information is laid out on a disk. This information is stored in a boot sector, the portion of the disk first contacted when the computer is turned on, or booted up.

disk platter—A magnetic metal disk that holds data inside of a fixed disk drive. There are multiple platters inside a single hard drive. See **hard drive**. See **platter**.

disk server—On a network, a remote disk drive accessible by some or all members of the network. Data can be written to and read from a disk server by members of the network.

disk swap file—See **swap file**.

disk unit—Any disk drive or its casing.

diskette—A transportable device on which computer data are stored. Diskettes, also called floppy disks, are thin square-shaped objects that come in two sizes: the 5.25-inch diskettes that are flexible and the 3.5-inch diskettes that are contained in a rigid plastic casing. (Eight-inch diskettes, which originated in the early 1970s, were quickly replaced by the 5.25-inch diskette and are obsolete today.) The 5.25-inch diskettes traditionally come in two formats: the low-density (also known as double-density) 360KB diskette and the high-density 1.2MB diskette. The 3.5-inch diskettes also come in two formats: the 720KB low-density (also known as double-density) diskette and the 1.44MB high-density diskette. The 3.5-inch 1.44MB diskette is presently the most popular diskette in use. Diskettes feature a tab that can be set either to allow the writing of data or to mark a diskette as read-only. Diskette drives look to see that this tab is in the write position before altering or recording data on the diskette. On 3.5-inch diskettes, this tab, located on the diskette's upper-right corner, can be moved back and forth to change the setting. On older 5.25-inch diskettes, a hole punched in the corner of the diskette indicates a read-only disk. The hole can be covered with tape to enable recording. See **3.5-inch diskette**. See **5.25-inch diskette**.

diskette drive—A peripheral storage device used to record data to and retrieve data from diskettes. The diskette drive, usually referred to as the A: or B: drive, has a smaller storage capacity than a hard drive or a CD-ROM drive and is the slowest to operate. Diskette drives are usually used for temporary and portable backup document storage. Also called floppy disk drive.

diskless workstation—A computer on a network that does not provide any local disk storage facilities. All information must be saved to a central disk drive on the network server. Diskless workstations enable users to view and change data on a network but cannot function alone. See **network server**.

dismount—The act of removing an application from the desktop in a Macintosh computer. Also, disabling a network resource. For example, dismounting a network drive. See **desktop**.

display—The image or text viewed on a monitor. More recently, display has become synonymous with the monitor itself, particularly when referring to flat panel displays.

display adapter—See **video adapter**.

display attribute—The characteristics of an object viewed on a monitor. Display attributes are anything that distinguish the appearance of a graphic or textual on-screen image, such as color, shape, and size.

display background—See **wallpaper**.

display board—A printed circuit board that connects a computer's video capabilities to the CPU.

display card—See **display board**.

display cycle—The complete process involved in projecting an image onto a display screen for viewing, including creating the image, transmitting the data from the storage device to the monitor, and refreshing the image for clarity.

display element—A simple image, such as a line, arc, or circle, that is combined with other elements to form one image.

display face—A font used to distinguish headlines and titles from the standard document font type. Headlines and titles appear in display face. Compare to **body type**.

display frame—A single frame of animated film.

display image—The collection of icons, graphics, and text displayed on-screen at a given time.

Display PostScript—An extended version of PostScript. Display PostScript is a standard image-description language used to control and manipulate the appearance of an on-screen image. See **PostScript**.

display screen—The part of the monitor on which images are viewed.

display terminal—A computer system consisting of a monitor for output, a keyboard for input, and a video adapter. The information entered on the keyboard is transmitted via a cable to another computer. This computer processes the information and sends it back to the display terminal, where the video adapter translates the information into an electronic signal that will appear as an image on the screen. A display terminal is often used as a data entry node on a network.

distortion—Any interruption or disruption of a transmitted signal that results in an unclear reception.

distributed database—In a network, a database physically stored in multiple computer stations, or nodes. Although the information contained in a distributed database exists in two or more systems, it is treated as a single collection. When the system updates one set of information the additional sets also are updated automatically.

distributed database management system (DDBMS)—A program that arranges, secures, and retrieves information located in a distributed database. The distributed database management system essentially controls the contents of a database, allowing for the transfer of data within a networked computer system as well as formatting data for printing.

distributed intelligence—On a network, the apportionment of processing capabilities among its stations or nodes.

distributed network—A system of computer stations in which processing, data storage, and accessibility to databases are shared among individual nodes.

distributed processing—A networking system that allows various processing tasks to be performed by different computers. Usually, each computer will manage one function but remain supported by the entire network.

distributive sort—A system of data organization that divides any list into parts and then rearranges them into the desired order.

dithering—A graphics technique that uses a mixture of colored or shaded dots to create a new color. For example, the ratio of blue dots to yellow dots in a contained area will determine the shade of green.

Divx—See **digital video express**.

DLL—See **dynamic-link library**.

DMA—See **direct memory access**.

DNS—See **domain name server**.

do-nothing instruction—See **no-operation instruction**.

docking station—A device that acts as a terminal to connect a portable computer to other equipment, such as a network or a desktop monitor and keyboard.

document—A textual or graphical compilation of data that is dependent upon an application program for its creation but is treated independently from the application's files for storage purposes.

document file—See **data file**.

document interchange architecture (DIA)—A structure that organizes and arranges for the exchange of text and graphics files between different computers.

document processing—The act of changing stored data. The change may

D

involve translating data into a form that can be presented for viewing, removing or adding data to a document, or rearranging data within the document.

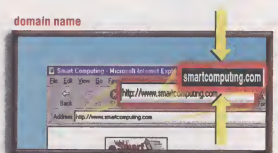
document reader—A peripheral component that converts characters on a printed sheet of paper, such as a hard copy of a magazine article, into a digital binary code that can be read by a computer system. A fax machine is a type of document reader. See optical scanner.

document retrieval—An indexing process built into some applications that lets users search for particular documents using key pieces of information, such as keywords, the date, author, or in some programs, previously designated keywords. After the computer locates the document, it can be retrieved for viewing or use. Some programs, such as Microsoft Word, let the user further refine a search by specifying more than one condition. A user could set the search criteria to include the author's name, the month it was created, and keywords in the document. In Word, a search criteria might read: "Find files that match these criteria: Author is Brian Jones; creation date on or after Monday, July 01, 1996; keywords include the word physics." The system then retrieves all documents that match this criteria.

document window—The window that displays the graphics or text file within the application window in a graphical user interface (GUI). In the Windows operating environment, each application has its own window on the screen. Each graphics or text file has its own document window within the larger application window. For example, several Microsoft Word documents might appear in several windows inside the Microsoft Word window.

documentation—The online or hard copy instructional information, such as tutorials, specifications, or reference guides, that is included when you purchase a piece of hardware or software.

domain—In a database management system, the limited range of valid values for a field. For example, a domain might be restricted to numeric characters, as in the case of telephone numbers. On Transmission Control Protocol/ Internet Protocol (TCP/IP) networks, such as the Internet, a domain is a group (large or small) of connected computers. Within a domain, there might be subdomains. On the Internet, domains are denoted by a three-letter code. Some of the largest, most common domains are as follows: .edu—educational institution; .gov—government site, other than state-funded universities; .com—commercial site; .mil—military site; .net—network site; .org—nonprofit or private organization. In addition, most countries, states, provinces, and regions have domain names. Subdomains range from fairly broad categories, such as a university, a military base, or a large corporation, to small intranets and single computers. A domain also can refer to a group of workstations on a network.



domain name—The identifying title given to a system of computers, usually including the top domain and all of its subdomains. For example, a domain name, such as socrates.nd.edu, indicates that the Socrates network is found at the University of Notre Dame (nd), which is an educational institution (edu).

domain name server (DNS)—On the Internet, a central computer to which all other computers of a domain or subdomain are ultimately linked. The domain name server translates the domain name into an Internet Protocol (IP) address to direct information from within the domain to other computers on the Internet. It also translates IP addresses into domain names. See Internet Protocol address.

domain name system (DNS)—See domain name server.

dongle—A device that locks hardware or software to prevent unauthorized use. Often a small metal key that secures the hardware contained within a computer case. The dongle can prevent a computer from being booted.

dopant—An impurity added to silicon during the manufacturing of a computer chip to control how well the silicon conducts electricity.

doping—Adding impurities, called dopants or doping agents, to silicon during the manufacturing of a computer chip to increase or decrease the chip's electrical conductivity.

DOS—See Disk Operating System.

DoS Attack—See denial of service attack.

DOS-based computer—Any IBM-compatible computer that uses the DOS operating system to control its fundamental operations. Generally, the term describes computers that run DOS but not Windows. See Disk Operating System.

DOS extender—A small DOS memory managing program that extends conventional memory (the first 640KB of memory) by reserving a section of the upper memory area (the portion between 640KB and 1MB) to be used solely by DOS components. See conventional memory. See Disk Operating System. See extended memory.

DOS prompt—See prompt.

DOS Protected Mode Interface (DPMI)—An interface that lets DOS programs operate in Protected mode, which lets DOS applications support multitasking and use portions of memory that extend beyond the 640KB memory restriction of Real mode. See Protected mode. See Real mode.

dot—A single pixel on a matrix graphics display, or a period separating related pieces of information in Internet addresses and file names. See pixel.

dot-addressable mode—A function that allows an individual pixel, or dot, to be individually addressed, located, and manipulated by a program.

dot matrix—A method of forming graphics or text by plotting tiny points on a grid. A matrix with high dots per inch (dpi) capabilities will have a better resolution and sharper image than a matrix with low dpi.

dot matrix printer—A type of printer that employs a moveable print head with pins, or wires, that shoot out and strike a ribbon. Each strike of a single pin creates a dot on the paper. Characters are formed as a pattern, or matrix, of dots. The quality of a dot matrix printer is determined by the number of pins it uses to create each character. A 24-pin dot matrix printer will produce typewriter-quality characters. Although laser and inkjet printers have practically replaced dot matrix printers for printing text and graphics documents, dot matrix printers are still used for printing labels and multiple-part forms. They also accept thicker paper than laser and inkjet printers can.

dot pitch—The distance, measured in millimeters, between pixels on a computer monitor. The smaller the dot pitch, the sharper the image. A comfortable dot pitch for viewing is between .22 and .28 millimeters. See **pixel**.

dots per inch (dpi)—A measure of printer resolution that indicates how many ink dots the printer can place in one square inch. The larger the dpi, the sharper the printed image. A text printer should have at least 600 dpi; a graphics printer should have at least 1200 x 600 or 1200 x 1200 dpi.

double buffering—The use of two buffers, or temporary memory storage areas, rather than one when communicating with an input/output device. While many devices might use a single buffer to hold data as they flow into or out of the computer, double buffering allows one buffer to send its data on while the other begins to take on data. This speeds processing time by improving data movement through the I/O bottleneck. See **input/output**. See **buffer**.

double-click—Two depressions of the mouse button, performed rapidly and without moving the mouse. Double-clicking is one method of opening an application in graphical user interfaces (GUIs) and also can be used to activate commands.

double dabble—A system of translating binary numbers into their base-10 equivalents. The farthest left binary digit is doubled, then added to the digit to its right. The sum is doubled and added to the next digit to the right. This continues until the final binary digit has been reached, at which time the total will reveal the base-10 equivalent of the original binary number. For example, to determine the base-10 equivalent of the binary number 1010, double the one, then add it to zero. Double that sum (2 + 2) and add it to one. Double that sum (5 + 5) and add it to zero. The total sum is 10, which is the base-10 equivalent of the binary number 1010.

Double Data Rate RAM—A type of synchronous dynamic random-access memory (SDRAM) also known as SDRAM II. See **Synchronous Dynamic random-access memory**.

double-density disk—See **double-density diskette**.

double-density diskette—A diskette capable of storing twice the capacity of single-density diskettes. A 3.5-inch double-density diskette can hold 720KB of data and 5.25-inch double-density diskettes can hold 360KB of data. Packages of double-density diskettes are usually labeled 2S/DD for "two-sided, double-density." Although some older model computers still use double-density diskettes, most computers use high-density diskettes, which can store even more data. High-density diskettes are usually labeled HD. Double-density diskettes also are called low-density diskettes. Compare to **single-density diskette**. Compare to **high-density diskette**.

double-scan display—See **dual-scan display**.

double-sided disk—See **double-sided diskette**.

double-sided diskette—A portable storage device that can have data recorded on both sides. Also called double-sided disk.

double word—In computer memory, a word is 16 bits of information. Twice that amount, or 32 bits, is a double word. Double words are read together as one unit by the microprocessor.

downlink—Data transmission from a satellite to a reception station on Earth.

download—To retrieve an application or file from another computer through a network connection or modem. Download is synonymous with "receive," while upload is synonymous with "transmit." Compare to **upload**.

downloadable font—A printer font that must be downloaded from the disk file to the printer memory before it can be used to print documents. Downloadable fonts expand the range of possibilities for document printing. Also called soft font. See **download**.

downsizing—The process of replacing a mainframe- or minicomputer-based computer system with a network of personal computers. This allows for more power at a considerably lower cost. See **mainframe**. See **minicomputer**.

downstream—The receiving end of a data flow. For example, the flow of information from the Internet to a personal computer is downstream. With home Internet connections, there's often a difference in speed between downstream and upstream data. 56K modems can receive data at 53 Kbps, but can send it at only 33.6. So, the downstream bandwidth is greater than upstream. Generally speaking, the same goes for other methods of connecting to the Internet, including cable modems, DSL, and satellite. See **upstream**.

downtime—The time when a computer is not functioning due to a hardware or software problem. Compare to **uptime**.

downward-compatible—See **backward-compatible**.

DP—See **data processing**.

dpi—See **dots per inch**.

DPMI—See **DOS Protected Mode Interface**.

DR—See **destructive readout**.

DR-DOS—A disk operating system developed by Digital Research for IBM-compatible computer systems. Soon after DR-DOS was released in 1990, Novell purchased Digital Research. Although often credited with providing the competition that forced Microsoft Corp. to improve MS-DOS, DR-DOS was discontinued due in part to the overwhelming popularity of the Windows operating system. Compare to **IBM DOS**. Compare to **MS-DOS**. Compare to **PC DOS**. See **Disk Operating System**.

draw tool

draft mode—A function on many printers that allows the characters to be formed with as few dots or as little ink or toner as possible. Despite its substandard quality, draft mode is used for rough drafts because it is quicker and more economical than the normal printing mode.

draft quality—The quality of printing done in the draft mode. See **draft mode**.

drag—To use a mouse to move an object or icon in a graphical user interface (GUI). A user can position the cursor on a selected object, hold down the mouse button, move the cursor to the desired location, and then release the button. This is usually used to move or highlight an object or a section of text. Some interfaces, such as Windows 95, let users drag a box around an item to select it. This is done by positioning the cursor near an object or group of objects, holding down the mouse button, moving the cursor to a position on the other side of the object(s), and releasing the mouse button.

drag and drop—In a graphical user interface (GUI), the act of moving an object, or icon, into another object to initiate a process.

drag and fill—A feature of spreadsheet programs (notably Lotus 1-2-3 and Microsoft Excel) that lets users fill cells by requiring information only in the first example. To enter consecutive months in Excel, for example, the user only needs to enter January in the first cell, then click and drag down on the black square in the bottom-right corner of the cell. Pulling down through five more cells would cause the program to enter the next five months.

drain—The amount of voltage an instrument has consumed from its power source.

DRAM—See **dynamic RAM**.

DRAW—See **direct read after write**.

draw tool—Any device used in conjunction with a drawing program that allows the cursor to be used as a pen to create and manipulate an image or shape.

drawing program—An application that allows for the creation and manipulation of object-oriented, or vector, graphics rather than bit-mapped, or raster, images. An example of a drawing program is CorelDRAW!. Painting programs, such as Windows Paintbrush, are used to create and manipulate bit-mapped images. See **bit-mapped graphics**. See **object-oriented graphics**.

drawing tablet—See **graphics tablet**.

DRDW—See **direct read during write**.

drift—The wave-like movement of any line that appears on a monitor.

drive—See **disk drive**.

drive bay—The system unit space reserved for the installation of any type of drive. These slots are usually located on the front panel of a computer. Empty drive bays may be protected by a plastic cover. To install many types of add-on components, an empty drive bay is required.

drive electronics PCB—A type of hard drive with the disk controller built in. This type of hard drive is commonly found in most newer personal computers.

drive letter—In an IBM-compatible system, the alphabetic character assigned to a drive that identifies it from the other drives. In most desktop computers, the 3.5-inch diskette drive is A:, the 5.25-inch diskette drive (if available) is B:, the hard drive is C:, and the CD-ROM drive is D:. These letters can be reassigned by the user.

driver—See **device driver**.

DRO—See **destructive readout**.

drop cap—The first letter of a text document that has been enlarged so it encompasses vertical space on lines above or below it. Drop caps are used to incorporate graphical elements where there would otherwise be only text.

drop-dead halt—See **dead halt**.

drop-down list—A standard element of graphical user interfaces (GUIs) in which one option is presented along with a small button, usually represented by a downward-facing arrow. Clicking the arrow with the mouse causes a list of other options to appear below the first. The user then can select from the options by clicking one. The drop-down list then disappears, leaving the selected option displayed in the original box next to the arrow button.

drop-down list box—See **drop-down menu**.

drop-down menu—In a graphical user interface (GUI), a menu that is opened when the menu name is clicked, letting the user choose one command from a list of several options. The File menu of a word processing document is an example of a drop-down menu.

drop in—A read/write error that occurs as a result of falsely detecting a nonexistent data signal. A drop in can occur while reading data from, or writing data to, any storage device.

drop out—A read/write error that occurs as a result of losing contact with the data signal. A drop out can occur while reading data from, or writing data to, any storage device.

drop shadow—The three-dimensional shading that appears behind a dialog box or button in a graphical user interface (GUI). Drop shadows also can be used in desktop publishing to enhance a letter, box, or drop cap.

drum—A rotating cylinder in page printers that is used to transfer images to paper. As a sheet of paper passes under the drum, the temporarily stored image is transferred to

the page in a manner similar to photocopying. See **page printer**.

drum plotter—A plotter that uses a drum-shaped revolver to hold paper during printing. The drum shape allows the plotter to be more space-efficient than a flatbed plotter. A plotter is a printing mechanism that writes the text or image to the paper by coordinating, or plotting, the points on a grid. Compare to **flatbed plotter**.

DSL—See **Digital Subscriber Line**.

DSP—See **digital signal processor**.

DSR—See **data set ready**.

DSVD—See **digital simultaneous voice and data**.

DTE—See **data terminal equipment**.

DTP—See **desktop publishing**.

DTR—See **data terminal ready**.

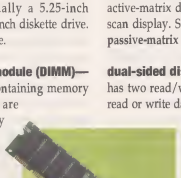
dual channel controller—A circuit that monitors and directs the flow of a transmission current along two courses.

dual density—An attribute of a diskette drive that lets it read or write data onto diskettes of different densities.

dual disk drive—See **dual diskette drive**.

dual diskette drive—Two diskette drives on one computer, usually a 5.25-inch diskette drive and a 3.5-inch diskette drive. Also called dual disk drive.

dual in-line memory module (DIMM)—A small circuit board containing memory chips. These boards are inserted into memory expansion slots to increase the amount of a computer's random-access memory (RAM). DIMMs differ from single in-line memory modules (SIMMs) in the width of memory bus supported. With a SIMM, opposing pins on either side of the board are "tied together" to form a single electrical contact; on a DIMM, opposing pins remain electrically isolated to form two separate contacts, doubling the number of circuit paths. This lets DIMMs support 64-bit and higher memory buses, while SIMMs are limited to 32-bit buses. This means that in computers with Pentium processors, which require a 64-bit memory bus, you must install SIMMs in pairs, but DIMMs can be added singly. Before buying memory make sure you know which type your motherboard supports. See **single in-line memory module**.



dual in-line memory module (DIMM)

dual inline package (DIP)—A tiny hard-plastic housing unit generally used to encase integrated circuits in older-model computers. The casing made it easier to solder the circuits onto a circuit board. Newer computers require too many connections to make a DIP feasible.

dual processor—A computer that has two processing units. These processors share data processing duties, which lets the computer better manage intensive processing demands and improve overall processing efficiency.

dual-ported memory—See **video RAM**.

dual-scan display—A type of passive-matrix display used mainly in portable computers that allows a screen to be refreshed twice as often as the regular passive-matrix display. Dual-scan displays, although of higher quality than a regular passive-matrix display, are still not of the same quality as active-matrix displays. Also called double-scan display. See **active-matrix screen**. See **passive-matrix display**.

dual-sided disk drive—A disk drive that has two read/write heads so the drive can read or write data onto both sides of a double-sided diskette. A dual-sided disk drive lets the user record or retrieve information from a diskette without having to eject the diskette from the drive to turn it over.

dumb terminal—A computer station consisting of a keyboard and monitor that has no local processing power and is used to enter data into a remote mainframe or miniframe computer. Compare to **desktop computer**. Compare to **smart terminal**.

dummy—A temporary file, document, program, process, or alphanumeric character that is used to hold a place for another file, document, program, process, or character. When the actual information is available, the dummy information is deleted. Dummy is often required as a place holder when a program cannot deal with blank spaces while waiting for data to arrive.

dump—A list of data contained in a computer's memory when a program is prematurely terminated. The data list is either saved to diskette or sent directly to a printer. A dynamic dump lets program developers track what is happening in the memory during any given moment in the execution of an application.

duplex—See **duplex channel**.

duplex channel—In asynchronous communication, a channel that can simultaneously transmit and receive data signals.

duplex printing—Printing on both sides of a sheet of paper so, when bound, the corresponding pages face each other, as in a book.

duplex system—A preventive measure operated by two computer systems. One computer performs the processing and the other remains on standby, ready to execute the processing tasks if the first computer malfunctions.

duplex transmission—See **full-duplex transmission**.

duplicate key—A character that represents a frequently occurring number or value.

DVD—See **digital video discs**.

DVD+RW—A format for rewriteable DVD discs that can be written to many times, not just once like DVD-Recordable (DVD-R) discs. DVD+RW offers slightly more storage capacity at three gigabytes (GB) than a competing format, DVD-RAM, which has

2.6GB. DVD+RW is also backed by three major computer equipment manufacturers: Hewlett-Packard, Philips, and Sony. The format is not compatible with DVD-RAM, but DVD+RW drives are usually able to read DVD-R as well as most forms of CD-ROM discs (CD-R, CD-E, CD-I, and audio CDs). Compare to **DVD-RAM**. See **backward-compatible**. See **Digital Video Discs**.

DVD-R—See DVD-Recordable.

DVD-RAM—Digital video discs (DVD) that can be written to many times, not just once like DVD-Recordable (DVD-R) drives. These discs, thanks to their huge storage capacity, 4.7 gigabytes (GB) per side, are likely to eventually replace CD-Rewriteable (CD-RW) drives. This format is being developed by the DVD consortium and is competing with rival format DVD+RW. The two formats are not compatible, but DVD-RAM drives will probably be backward compatible, with the ability to read DVD-R as well as most forms of CD-ROM discs (CD-R, CD-E, CD-I, and audio CDs). See **Digital Video Discs**. Compare to **DVD+RW**.

DVD-Recordable (DVD-R)—DVD-R discs are similar to CD-Recordable (CD-R) discs because they can be written to, but only once. DVD-R discs can store many times more information than CD-R discs, 2.6 gigabytes (GB) compared to about 700 megabytes (MB). See **CD-recordable drive**. See **Digital Video Discs**. See **DVD-RAM**.

DVD-ROM—Any DVD disc used for storing computer data, or the type of drive used to access such a disc. DVD-ROM drives are similar to CD-ROM drives in that they are generally used in computers and can be used with both DVD-video and DVD-ROM discs. DVD-ROM drives are usually backward compatible, able to read most forms of CD-ROM discs (CD-R, CD-E, CD-I, as well as audio CDs). See **backward-compatible**. See **Digital Video Discs**.

DVD-Video—The type of DVD disc used for storing movies. The term also refers to the type of DVD player, which is used as a set-top box to hook up to televisions or home entertainment systems. In short, it distinguishes a DVD disc used solely for storing video from those used for storing computer data. Often, these discs are referred to solely as DVD discs. Industry experts expect DVD to replace VHS videotape as the standard format for storing and watching movies, thanks to the exceptional sound and video quality of DVD movies and the relatively low price of DVD players. DVD-Video finally offers a realistic method for storing movies in high-definition digital form. Laser discs, which DVD is also expected to replace, offer high-definition digital picture and sound but are bulky—they are large discs (about a foot wide) that are easily damaged and often require viewers to get up and flip the disc midway through the movie.

DVI—See **digital video interactive**.

Dvorak keyboard

Dvorak keyboard—A keyboard that situates all vowels and punctuation marks on the left side of the keyboard and consonants on the right side. The layout, developed in 1936 by August Dvorak, is more efficient than the standard QWERTY keyboard because it reduces the distance fingers must travel to type common words. However, the system is still not widely used because of implementation costs. See **keyboard layout**. Compare to **QWERTY keyboard**.

DVST—See **direct view storage tube**.

dynamic address translation (DAT)—A procedure that converts relative memory addresses, such as "X+3," to absolute addresses, such as "address 123." Dynamic address translation occurs as needed while a program is operating. Dynamic address translation is not related to digital audio tapes (DAT).

dynamic allocation—During program execution, the process of appropriating memory space to accommodate certain operational needs.

dynamic data exchange (DDE)—A two-way connection between multiple programs that lets the programs actively exchange data while both programs are running. This exchange of data without user intervention is known as a conversation. Available with Windows and OS/2, this feature lets users use one program to manipulate data in another program. For example, if you use a communications program and a modem to connect to an information bulletin board, you can use a DDE to connect the incoming information to a word processing template for viewing. The incoming information may change, but the template will remain the same.

dynamic data link (DDL)—A feature in Windows that links information in one file to information in another file. For example, a DDE could be used to link information in a spreadsheet to information in a project management program. Changing information in the spreadsheet would automatically update the information in the project management program.

dynamic dump—Terminating a program prematurely in order to record a list of the operating commands and memory functions that are active at the time the application is stopped.

dynamic-link library (DLL)—An executable subroutine stored as a file separate from the programs that may use it. DLLs, which allow for the efficient use of memory because they are loaded into memory only when needed, are used extensively in Windows and OS/2. The DLL file name extensions are .DLL, .DRV, and .FON.

dynamic RAM (DRAM)—(Pronounced Dee-ram.) A type of computer memory that employs a system of transistors and capacitors to retain data. DRAM is slower and less dependable than static RAM because the capacitors cannot maintain an electrical charge and need to be refreshed every millisecond, but it is cheaper, takes up less space, and uses less power. Compare to **static RAM**.

dynamic relocation—In an active program, the relocation of data or command code in memory to create more efficient memory storage.

dynamic scheduling—The ability of the operating system to manage two or more programs running at the same time.

dynamic storage—A temporary storage location, such as RAM, that loses all recorded data when the power supply is removed.

E1—The European equivalent of a T1 Internet connection, with a top speed of 2.048 megabits per second (Mbps). See **T1**.

E-commerce—Short for electronic commerce, or business conducted online. The term applies to everything from consumer purchases to corporate purchases where the transaction takes place online. E-commerce applies to more than just online sales, however. It can also refer to using the Internet for business purposes, such as E-mailing newsletters to customers or providing a web site with information for prospective customers that results in phone sales or inquiries.

E-mail—See **electronic mail**.

Easter egg—Slang for little surprises a programmer hides within an application. Users press a special key combination or perform a sequence of actions and an unexpected event takes place on-screen. Although users can hunt for them, it's more likely they'll find Easter eggs by accident or word-of-mouth. For example, Windows 3.1 users can find an Easter egg in the Program Manager. They can select the About Program Manager option in the Help menu. Then Double-click the Windows logo while holding down the CTRL and SHIFT keys. Click OK to close the window. Open the About Program Manager window again and double-click the Windows logo while holding down the CTRL and SHIFT keys. An Easter egg note will appear. Users can repeat the procedure to see another egg.

EBCDIC—See **extended binary coded decimal interchange code**.

echo—An echo can mean several things in communications and computers, but all generally follow the same idea: sound or data is "echoed" back to the sender. Echoing is used when transmitting data over phone lines with a modem to double-check that all the information is received correctly. Echo can be used over a network, in which each terminal echoes a message back to the host computer to make sure it received information correctly. ECHO is also a DOS command that can display text on-screen, or hide it, in batch programs (by typing echo on or echo off); it also can display a message on the screen (by typing echo followed by the message).

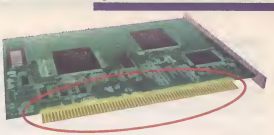
echo check—A precise use of an echo in communications to ensure data are transmitted completely and correctly. The computer that receives the data echoes what it received back to the sending computer. The sending computer checks the information for errors and retransmits the data if inconsistencies are found. See **echo**.

echo suppressor—A device used to eliminate the echo heard on telephone lines. The echo suppressor switches back and forth to let the speaker send a strong signal to the listener without hearing an echo of his or her own voice. During full-duplex modem communication, the echo suppressor must be switched off to let the two modems exchange data at the same time.

echoplex—A kind of visual echo check. When users type something on-screen to send to another computer via modem, it is echoed back to the screen so the message can be visually checked for inconsistencies by the user. See **echo**. See **echo check**.

ECP—See **extended capabilities port**.

edge connector—Found along one edge of an expansion card, edge connectors are made up of lines or strips of metal that fit into an expansion slot inside a computer or to a ribbon cable connector. Through these metal lines the card connects to the computer's bus and passes along data and signals. The number of connectors will differ



edge connector

depending upon the type of bus: PCI, ISA, or EISA. That's why it's imperative to make sure the device being attached will work with a computer's bus type. See **bus**. See **Extended Industry Standard Architecture**. See **Industry Standard Architecture**. See **Peripheral Component Interconnect**.

EDI—See **electronic data interchange**.

edit mode—A mode in which files can be changed, as opposed to command mode, in which the application waits for the user to issue commands.

editor—Also known as a text editor, a type of program that lets users create and manipulate text files. There are several kinds of editors. A regular, full-screen editor lets users edit the text seen on-screen by navigating the file with the cursor or arrow keys. A line editor is a little more awkward, numbering each line in the document. To make a change, users first must indicate to the editor the number of the line to be changed so the editor will take them there. An editor is not as full-featured as a word processor; generally text editors don't include features such as italics or spell checking. Editors might be used to make changes to some system files, such as Config.sys or Autoexec.bat.

EDLIN—The line-editor program supplied in Microsoft DOS (MS-DOS) versions older than 5.0. Although EDLIN lets users modify text line by line; it does not offer the powerful editing capabilities found in true word processing packages. To edit a DOS text-based system file with EDLIN, type edlin followed by the name of the file. Later versions of DOS use DOS Editor, a full-screen editor that is menu-driven rather than command-driven. To edit a DOS file with the DOS Editor, type edit followed by the name of the file. See **editor**.

EDO RAM—See **Extended Data Output RAM**.

edutainment software—Software, generally for children, that blurs the line between education and entertainment. These programs combine learning with entertaining activities, such as games.

EEPROM—See electrically erasable programmable read-only memory.

EGA—See enhanced graphics adapter.

E

egosurfing—The practice of searching databases, newspaper articles, reference services, and other World Wide Web sites for one's own name.

EIDE—See Enhanced Integrated Drive Electronics.

eight-dot-three rule—The rule describing the limit of file name sizes in DOS. File names can have an eight-character file name, followed by a three-letter file extension, such as .DOC, .TXT, or .JPG. Even though recent versions of DOS and Windows will let users use longer file names—even formerly restricted special characters such as spaces—the eight-dot-three file system still serves as the foundation. For example, DOS would recognize Sanfrancisco01.txt as a valid file name. A user could save a file with that name and successfully retrieve it later, but its actual file name would be Sanfra~1.txt.

EISA—See Extended Industry Standard Architecture.

ELD—See electroluminescent display.

electrically erasable programmable read-only memory (EEPROM)—A form of erasable, programmable ROM (EPROM) that can be erased and reprogrammed by an electrical process rather than being exposed to ultraviolet light. EEPROM remembers data when the power is turned off and is often used for a computer's BIOS. Generally, users need a special programmable ROM (PROM) device to change data in EEPROM. See **Basic Input/Output System**. See **programmable read-only memory**. Compare to **erasable programmable read-only memory**.

electroluminescent display (ELD)—The first flat screen with a wide angle in portable computers, this thin display uses electrical currents to give off light and create on-screen images. A layer of phosphor is sandwiched between two grids of horizontal and vertical electrodes. When the electrodes crisscross, pixels form and are illuminated by a current passing through the corresponding electrodes. These pixels (tiny picture elements) then combine to create the on-screen image. The liquid-crystal display (LCD) is largely replacing the ELD. See **liquid-crystal display**. See **pixel**.

electromagnet—This device creates a magnetic field by using an electric current. An example of an electromagnet can be found on the read/write heads of disk drives. Wire coiled around an iron core makes up the composition of these electromagnets. When the current passes through the coil, it generates a magnetic field. See **head**.

electromagnetic spectrum—The range of frequencies displayed by electromagnetic radiation. Visible light is a form of electromagnetic radiation, as are X-rays, microwaves, and radio signals.

electron gun—A component used in televisions and computer monitors to produce and manipulate the electron beam that creates images in cathode-ray tube (CRT) displays. See **cathode-ray tube**.

electron tube—A glass tube, also known as a vacuum tube, that holds electrical charges within a vacuum and is capable of turning on and off or amplifying electrical signals. These tubes were used in the first computers for digital processing, but have been replaced by transistors in today's computers. In fact, about the only place electron tubes are still in use is in cathode-ray tubes (CRT) within monitors and televisions. See **cathode-ray tube**.

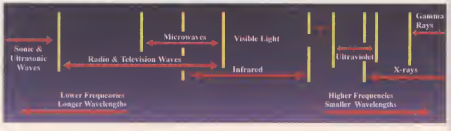
electronic data interchange (EDI)—Standards specifying how to format computerized business communications, such as orders and invoices. EDI should reduce paperwork and speed up processes by making sure business and customer computers can understand the data they send each other.

electronic mail (E-mail)—Text messages sent through a network to a specified individual or group. Received messages are stored in an Inbox and can be kept, deleted, replied to, or forwarded to another recipient, depending upon the E-mail program. Besides a message, an E-mail may have an attached file or graphic. Users can make sure a message was received by requesting a receipt. Although not all items can be sent electronically, E-mail's big advantage over postal mail, nicknamed "snail mail," is speed. E-mail can be delivered within seconds or minutes across thousands of miles. May also be spelled email or e-mail.

Electronic Numerical Integrator And Calculator (ENIAC)

Electronic Numerical Integrator And Calculator (ENIAC)—Completed in 1946 at the University of Pennsylvania, the ENIAC was the second electronic computer. It took up about 1,800 square feet and used about 18,000 vacuum tubes, weighing almost 50 tons. The computer was first developed to help with the war effort and was designed to calculate trajectories for new artillery used against German forces. However, the ENIAC was not completed until the end of the war. The ENIAC impressed the world with its debut by counting to 5,000 in one-fifth of a

eletromagnetic spectrum



second, although it probably had less computing power than some of today's calculators. The ENIAC contributed critical concepts for future computing, including the ideas of a "stored program" and the "if statement." Today's computers can store many programs and do not require the ENIAC's 40-pound trays of wires and vacuum tubes. They also include the "if statement," letting them choose among different outcomes based on diverse inputs. The ENIAC machine is on display at the Smithsonian Institution in Washington, D.C.

electronic office—A term describing the unrealized vision of the paperless office, where electronic versions of documents stored in computers completely replace paper stored in file cabinets and in piles on desks.

electronic publishing—A type of publishing in which the entire process, including the end result, is electronic. Electronically published documents are created, edited, and laid out on the computer. They are then published on diskettes, on CD-ROMs, through the Internet, or through an online service to be viewed with computers.

electronic storefront—A type of electronic commerce (E-commerce) where a virtual store offers product or service information, customer relations support, and oftentimes telephone, fax, E-mail, or direct mail ordering capabilities.

electronic whiteboard—Computer hardware and software that lets users at different PCs simultaneously view and annotate a document or image. The electronic version resembles an actual whiteboard users can draw on with a stylus or marker. Electronic whiteboards are integrated into conferencing systems using modems and ordinary phone lines or office networks so users at both ends of the conference can read and mark up documents. See **stylus**.

electrophotography—A technology combining elements of photography with electricity to reproduce images in printers and photocopiers. A negative image is created on an electrostatically charged drum. Where the light (from sources such as lasers or light-emitting diodes) comes through, the drum carries no charge. Powdery toner sticks to the charged areas of the drum and is transferred to paper, where it adheres due to pressure and heat. Laser printers, liquid-crystal display (LCD) printers, and light-emitting diode (LED) printers use electrophotographic means to recreate images on paper. See **laser printer**. See **light-emitting diode**. See **liquid-crystal display printer**.

electrostatic—An electric charge that does not flow through a medium but remains in one place. An electrostatic charge is responsible for attaching dust to computer screens and is also used in electrophotographic printers to hold toner particles on a drum, which then transfers the toner to paper. See **electrophotography**.

ELF emissions—See extremely low frequency emissions.

elite—A typeface that fits 12 characters in one inch with each character the same width as the others. Elite resembles the typeface created with ordinary typewriters. See **typeface**.

ELIZA—(Pronounced e-LIE-za.) Written by Dr. Joseph Weizenbaum as a joke, ELIZA was a famous psychotherapy computer program designed to converse with users by simply repeating statements back as questions and picking out specific keywords from previous comments made by the user. See **artificial intelligence**.

em—A typography unit of measure. In many fonts, it equals the width of the capital letter M.

em dash—A punctuation mark signifying a change of thought or further explaining an idea. Because most keyboards lack a key for the em dash (—), it is created with a special key combination specific to each program. The character is named after the em unit of measurement. If the actual em dash is unavailable, it can be imitated by typing two hyphens in a row (--). See **em**.

em space—Represents a space between letters or words the width of the point size. Named after the em unit of measurement in typography, the em space, in many fonts, is equal in width to the capital letter M. See **em**.

embedded command—When users embed a command in the text of a document, they insert it in a specific place to affect the text in that spot. For instance, someone might use embedded commands in a word processor to tell the program where he wants text bold, italicized, or in another font. The embedded commands are invisible but can be displayed for editing purposes.

embedded object—A copy of an object or file pasted into another file. For instance, users can incorporate a small spreadsheet created with spreadsheet software into a word processing report. If they want to edit that spreadsheet later, they select and begin editing it using the spreadsheet program's tools; but the word processor will remain open to the document at the same time. Objects and files embedded within the Microsoft Windows operating environment/system use Windows' Object Linking and Embedding (OLE). See **object linking and embedding**.

Emerging Behavior—Changes in the behavior of machines or robots with artificial intelligence that were not part of the machine's original programming. For example, a combat flight simulator that learns from its challengers and devises strategies and tactics not included in the simulation program. See **artificial intelligence**.

Emm386.exe—An executable file that runs the expanded memory manager in Intel 80386-based and higher computers. It uses extended memory to act as expanded memory, lets users load programs into upper memory, and must first be activated by adding several lines to the Config.sys system file in DOS. See **expanded memory**. See **expanded memory manager**. See **extended memory**. See **upper memory area**.

emoticons—Also known as smileys and short for emotion icons, these punctuation combinations form small pictures, often best viewed sideways. For example, users can form faces like this one to relay emotions: :-). Emoticons are most often seen in electronic mail (E-mail) and Internet messages.

empty tag—An single HTML tag that contains no text or images. The tag for a horizontal line, <hr>, is an example. See **Hypertext Markup Language**.

EMS—See **expanded memory specification**.

emulator—A device, in the form of hardware or software, that allows a computer or other device to act as something else. They're useful if, for example, a person wants to use software designed for an IBM or compatible computer on a Macintosh. An emulator, in the form of software or a special microchip, would let the Mac pretend it is an IBM or IBM-compatible. Windows 95 can emulate DOS to run software written specifically for the DOS environment. Or, a computer may act like a dumb terminal so it can connect to a mainframe computer (called terminal emulation). In addition, a chip can let printers use the same printer control language as other printers. For example, many printers can emulate Hewlett-Packard (HP) printers because of the numerous programs written for HP printers. See **terminal emulation**.

en dash—A dash smaller than an em dash (—) but longer than a regular hyphen; often used in place of the word "to." For example, "8-5 p.m." Compare to **em dash**.

en space—A space taking up only half a point size, named after the typography unit of measurement en. Compare to **em**. See **em space**.

Encapsulated PostScript (EPS)—A graphics file format that includes PostScript commands, which tell a PostScript printer how the file should be printed. PostScript is a language used on advanced graphics and desktop publishing files for better reproduction. An EPS file includes a bit-mapped representation of itself for viewing on-screen but requires a PostScript printer for proper printing. EPS files will ordinarily be followed by the .EPS extension. See **bit-map**. See **PostScript**.

encode—To change something into a programming code. For instance, you can change a letter into the binary code for that letter or change an analog sound into a digital file. Sometimes encode means encrypt. See **encrypt**.

encoder—A hardware device or software program that encodes information into digital form. See **encode**.

encrypt—The act of encoding a file for the purpose of preventing others from gaining access to its contents. An encrypted file appears as a string of gibberish. In order to read or use the file, it must be decrypted. Files are usually encrypted using encryption programs. In most cases, only users with the correct password are able to use the encryption program to make the file readable again. See **data encryption standard**. See **decryption**.

END key—A key on most computer keyboards that moves the cursor to the end of the line, paragraph, page, screen, or document, depending upon the program and specific key combination used.

end-of-file (EOF)—A code placed by a computer, after a file's last byte of data. EOF marks are helpful in data transmission and storage. Because files are stored in blocks, the end marker helps the computer know it has allocated enough space to store each specific file.

end-of-line (EOL)—A code or mark a user or computer places at the end of a line of text to indicate a line ending.

end-of-message (EOM)—In communications, this code or mark is used to signal the receiving computer that transmission of the full message is complete.

end-of-text (ETX)—In electronic communications, a code or mark that is used to signal the receiving computer that the transmission of an entire text file is complete. However, there may be other transmission checking codes or marks that follow to check that everything was sent correctly. Therefore, users should not assume that the ETX code means a transmission is complete.

end-of-transmission (EOT)—In communications, a code or mark used to signal the receiving computer about the end of a complete transmission. This happens after the file is transmitted and any error-checking codes have been finalized.

end user—The person who uses hardware or software programmed or designed by another person.

Communication Shortcuts

AAMOF—As a matter of fact	LJBF—Let's just be friends
AFK—Away from keyboard	OIC—Oh, I see
BBFN—Bye bye for now	OTOH—On the other hand
BTW—By the way	TIC—Tongue in cheek
BYKT—But you knew that	TTFN—Ta ta for now
CMIIW—Correct me if I'm wrong	TYVM—Thank you very much
EOL—End of lecture	<G>—Grinning
FITB—Fill in the blank	<S>—Smiling
IAC—In any case	<L>—Laughing
IMHO—In my humble opinion	<J>—Joking

What Are You Smiling About?
Here are some of the most popular emoticons.

:-)	Smile	:'->	Happy and crying	:-o	Surprised
;-)	Winking	:-@	Screaming	>:-<	Mad
:-(	Frowning	:-&	Tongue tied	:-O	Uh Oh
:-|	Indifferent	:-S	Incoherent	:-/	Skeptical
:->	Sarcastic	:-\	Undecided	<:-|	Dunce
>:->	Devilish	:-c	Bummed out	:-*	Oops
:'-(	Crying	:-e	Disappointed	:-D	Big Smile

endless loop—A continuous repetition of a program segment, also known as an infinite loop. For example, in a BASIC program, an endless loop is created by using the GOTO command set to a previous program line.

Energy Star

Energy Star—An Environmental Protection Agency (EPA) program that encourages the production of PCs and peripherals that use less energy. For a computer, printer, or monitor to carry an Energy Star label, it must meet certain requirements. First, a device must sense when it has been left inactive for a specific amount of time. Once the device decides it is inactive, it must power down to a mode in which it consumes no more than 30 watts of energy. Monitors in this state, for example, will go blank. No data is lost when computer components enter a low-power mode, but it may take a few seconds for the computer to "wake up" once again. Usually pressing any key will bring a sleeping computer back to life.

engine—The part of an application controlling the manipulation of data. Do not confuse the engine with the interface or with things such as device drivers that help the software work with components in the computer. Engine also may refer to a special processor used inside the computer to speed up graphics printing (a graphics engine) or in a printer to aid printing (a printer engine). See **device driver**. See **interface**. See **printer engine**.

enhanced graphics adapter (EGA)—A high-resolution video card manufactured by IBM in 1984 that has more colors (16 from a palette of 64) and obeys the computer much faster than the older video cards, such as the color/graphics adapter (CGA). EGA cards can produce resolutions of 640 horizontal pixels by 350 vertical pixels, which is not quite as capable as the VGA card with 640 x 480 resolution but better than the CGA card with 320 x 200. See **color/graphics adapter**. See **pixel**. See **video graphics array**.

Enhanced Integrated Drive Electronics (EIDE)—Also known as Fast AT Attachment (Fast ATA), this is an updated version of the Integrated Drive Electronics (IDE) storage interface that works with hard drives and CD-ROM drives. It can shuttle data to and from the drive three to four times faster than the IDE standard (transferring data between 11MB and 16.6MB per second) and can support data storage devices that store up to 8GB more than IDE drives. See **integrated drive electronics**.

enhanced keyboard—This type of keyboard comes with most PCs sold today. It includes 101 or 102 keys. The biggest difference between enhanced keyboards and earlier versions is the enhanced keyboard has 12 function keys running across the top of the keyboard instead of 10 that run down the left side. Other changes include the addition of extra CTRL keys, ALT keys, and cursor arrow keys between the letter keys and numeric keypad on the right side.

Enhanced mode—This term is used in the phrase 386-enhanced mode. This is the Microsoft Windows mode used by 386, 486, and Pentium computers to take advantage of virtual memory. It lets computers run more than one program at a time so the programs do not interfere with each other's allocation of memory. It is the standard mode used by Windows for Workgroups and can be run by Windows 3.1, requiring at least 2MB of RAM. It also lets DOS applications run within a window in Windows. See **expanded memory**. See **extended memory**. See **virtual memory**.

enhanced parallel port (EPP)—A type of parallel port that looks like any parallel port with 25 pins and the same shape. However, it works twice as fast as the parallel ports that came on the original IBM PCs, and it transfers data back and forth between a peripheral device and a computer at the same time. This type of parallel port was developed by Intel, Xircom, and Zenith at the same time the extended capabilities port (ECP) was being developed by Microsoft and Hewlett-Packard. EPP is a popular type of port for many portable computers. See **extended capabilities port**.

ENTER key

enhanced serial Interface (ESI)—A standard introduced by Hayes Microcomputer Products for the serial port, which is commonly used to connect a modem or other such device to the computer. Along with an enhanced serial port, the connection allows for easy data transfer over phone lines with speeds up to 38.4 kilobits per second (Kbps).

Enhanced Small Devices Interface (ESDI)—A standard interface popular in the 1980s that allowed hard drives, tape drives, and diskette drives to work with a computer. It could transfer data at about 1MB to 3MB a second. ESDI has grown outdated with the introduction of storage interfaces such as Integrated Drive Electronics (IDE), Enhanced Integrated Drive Electronics (EIDE), and Small Computer System Interface (SCSI).

ENIAC—See **Electronic Numerical Integrator And Calculator**.

enquiry character—A code some communications devices send to other devices with which they're communicating in order to request a response for identification or to make a connection.

ENTER key—A key located on the right side of most keyboards that, when pressed, tells the computer to perform a typed or highlighted command. For example, a command typed at a DOS prompt is not executed until the ENTER key is pressed. In Windows, pressing ENTER will perform the function of whatever button, command, or option is currently highlighted. The ENTER key is also called the RETURN key. In word processing programs, ENTER is used to begin a new line or paragraph. In other programs, it may move the cursor to the next line or field.

Enterprise Resource Planning (ERP)—A process, usually involving specialized software, that helps businesses keep track of important activities, such as inventory control, parts ordering, and tracking orders. There is a wide variety of software in this field, from code written to perform a specific task at a specific company to mass-produced software that performs common tasks.

E

enterprise-wide network—A network connecting computers throughout an organization, including computers in different buildings or cities. This includes the computers, servers, gateways, and all the components that make up the network.

entry—Most often, an entry refers to a word, phrase, number, or other information users might enter into a spreadsheet or database cell or field. Although what users enter in one field may be more than one word or number, it is still considered a whole entry.

envelope—In communications, a unit of data consisting of information plus extra bits for transmission control and error checking. Envelope also refers to the shape of sound waves when they are created.

envelope delay—Occasionally, a portion of the signal's frequencies transmitted via modem may arrive before the rest of the frequencies because some frequencies travel faster, although they were all sent at the same time. This can distort the signal and cause some errors in the transmitted data. Also called delay distortion.

environment—The operating environment or system in which a user works. DOS is a text-based environment, while Windows and the Macintosh operating system (OS) are considered windowed or graphical environments. See **character-based interface**. See **graphical user interface**.

EOF—See **end-of-file**.

EOL—See **end-of-line**.

EOM—See **end-of-message**.

EOT—See **end-of-transmission**.

EPP—See **enhanced parallel port**.

EPROM—See **erasable programmable read-only memory**.

EPS—See **encapsulated PostScript**.

erasable programmable read-only memory (EPROM)—Memory similar to programmable ROM (PROM), but it can be erased when exposed to ultraviolet light. Hardware manufacturers like to use EPROM when they need changeable memory. For example, this kind of memory can be found on smart cards, modems, and in digital cameras. Compare to **electrically erasable programmable read-only memory**.

erase—To permanently remove the information contained on a storage medium. A computer erases data from a storage medium by writing zeroes and undefined characters over the old data. Files stored on magnetic media, such as disk drives and tapes, also can be erased with a bulk eraser, a magnetic device that restores media to its original blank state. Erasing data differs from deleting data. Deleting data does not remove it from a medium immediately; rather, the storage space containing the deleted files is designated as available for storing new data. The new data then overwrites the old data. See **delete**.

erase head—A tape drive component near the read/write head that erases information on the tape through demagnetization. See **head**.

ergonomics—The study or science of how people interact with their work areas. Ergonomics can help determine the proper setup of a chair, desk, or monitor height. It also can suggest the position of the hands on the keyboard or how to get rid of glare on a screen. The goal is to keep things as comfortable and effective as possible. Ergonomics has become common in the 1990s because computers have become a prevalent part of the office. Improper ergonomics may cause carpel tunnel syndrome and other repetitive stress injuries and conditions.

ergonomics

ERP—See **Enterprise Resource Planning**.

error correction coding—A way of detecting and repairing errors in files transmitted between computers or disk drives saving data. If there are too many errors in a set number of bits, error correction coding may be unable to fix the errors, and you may have to retransmit or resave the data depending upon the code being used.

error detection and correction—A communications process used during transmissions to ensure all data was sent without errors or discrepancies. While some programs won't do more than announce there was a problem and ask users to retransmit a file, some programs will fix the errors themselves. Two common detection protocols are checksum and cyclic redundancy checking (CRC). See **checksum**. See **cyclic redundancy check**.

error message—A message displayed by a computer to inform a user something is wrong and some action must be taken for the computer to continue. Whether it is a printer out of paper or a computer out of memory, error messages alert people to the fact that the operation they wanted the computer to perform is impossible, at least temporarily. Some error messages offer options to fix the problem while others are more cryptic and can be deciphered only with a good users manual.

error rate—A measure of a communication or network connection's reliability. Specifically, the number of units with errors compared to the total number of units transmitted. For example, 2 to 400,000 bits.

ESC key—See **escape key**.

escape key—A key marked ESC, located in the top-left corner of many keyboards. Its

function varies depending upon the program being used. By itself, the ESC key can be pressed to cancel an action, return to a previous program or menu, or completely close a program.

ESDI—See **Enhanced Small Devices Interface**.

ESI—See **enhanced serial interface**.

Ethernet—The most widely used local-area network (LAN) protocol, Ethernet was created by Xerox in 1976. Later the standard was rewritten by Xerox along with Digital Equipment Corp. and Intel. Ethernet is the original carrier sense multiple access/collision avoidance (CSMA/CA) LAN that lets PCs connected to the network listen for pauses before they "speak." Older Ethernet networks used either thin or thick coaxial cable to connect computers together. A newer system called 10Base-T uses wiring similar to that used in telephone systems and transfers data at up to 10 megabits per second. Fast Ethernet, known as 100Base-T, allows transfers at 100 megabits per second. Fiber optic Ethernet variations also let users extend network capabilities far from the base site. See **carrier sense multiple access/collision avoidance**. See **local-area network**.

ETX—See **end-of-text**.

evangelist—Many large hardware and software companies employ people as evangelists to build support for their products with the media, consumers, and product developers. While some companies actually give an employee an official evangelist title, it may only be a "nickname" at some businesses. Companies such as Apple, Corel, and Netscape Communications have evangelists. Apple even publishes an "EvangeList" newsletter.

even parity—During transmissions, error-checking methods may attach an extra bit, called a parity bit, to a set of transferred bits. It may be in the form of a 0 or a 1. If the method is using even parity, that extra parity bit makes all the bits add up to an even number. If it is odd parity, the extra parity bit makes all the bits add up to an odd number. See **parity**.

event—Something that happens or occurs within a computer's hardware or software. Some events are user-initiated and caused by pressing the Enter key, pressing another key, clicking the mouse button, or otherwise telling the computer to do something. Peripherals also cause events, such as when the printer indicates to the computer it is done printing. See **peripheral**.

EVGA—See **extended video graphics array**.

exa—Used as a prefix before a unit of measure, this terms equals about one quintillion, or 10 to the 18th power. To be more exact, it actually equals 1,152,921,504,606,846,976, or 2 to the 60th power.

exabyte (EB)—Approximately one quintillion bytes, or about 1,000,000,000,000,000,000 bytes. See **exa-**. See **byte**.

exception—In communications, anything that happens out of the ordinary. In programming, an exception is something caused by an error or a variation. It makes the microprocessor put what it is doing on hold to perform another set of instructions first.

executable file—A file that can be executed, or run, as opposed to data files, which are collections of data used by executable files. Executable files are identified by the extension .EXE or .COM (for example, Program.exe). Such files basically are lists of instructions for the computer to carry out. Also called a program file.

execute—To run a file or command, or to complete an action.

exit—A command or option that will let users leave and close a program. It may require a special keystroke or key combination in a DOS program, or it may require users to select the Exit option from the File menu in a Windows program.

expand—To change the view of a hierarchical listing in order to disply the entire branch of the directory. For example, in the Windows File Manager or Windows Explorer, the list of files could be expanded so all of the folders and files are showing, instead of just the list of folders. Compare to **collapse**.

expanded—A term used in some font applications in which the letters are spaced farther apart than usual. Compare to **condensed**. Compare to **font**.

expanded memory—The amount of memory past the first 640KB of memory (which is known as conventional, or base, memory), up to 1MB (or 1,024KB). Also known as the upper memory area, this area is used to hold programs and device drivers that otherwise use up conventional memory space. To operate properly in DOS, expanded memory requires a special manager application or an expanded memory manager. See **conventional memory**. See **expanded memory manager**. See **extended memory**.

expanded memory manager (EMM)—A device driver that lets computers running DOS use expanded memory. It requires additional hardware, in the form of an expansion memory board, to use the expanded memory manager in an 8088-, 8086-, or 286-based system, although a 386-based system and higher simply require the memory manager to turn extended memory into expanded memory. See **device driver**. See **expanded memory**. See **extended memory**.

expanded memory specification (EMS)—This specification lets DOS systems use more than one megabyte of RAM, swapping pages out of expanded memory into an area the operating system (OS) can access. Expanded memory is "expanded" past the first 640KB of memory (which is known as conventional, or base, memory), up to 1MB (or 1,024KB). Also known as the upper memory area, this area is used to hold programs and device drivers that otherwise use up conventional memory space. See **device driver**. See **expanded memory**. See **expanded memory manager**.

expansion—Adding extra hardware to your computer, such as a better graphics adapter, a DVD drive, a sound card, a second hard drive, extra RAM, an internal modem, and so on, to endow your PC with added capabilities and functionality. Usually this requires plugging an external device into a port on the computer or sliding a special circuit card into a slot inside the computer's case.

expansion card—An add-on electronic circuit board that gives a computer new abilities. Expansion cards are used to connect devices such as fax/modems, sound cards, graphics cards, hard drive and CD-ROM drive controllers, mice, or extra ports to a PC. They fit into expansion slots on the motherboard inside the computer's case. Portable computers use a special kind of expansion card called a PC Card, which fits into a PC Card slot in the portable computer. Also called expansion board. See **expansion slot**. See **PC Card**.

expansion slot—A slot or socket inside a computer allowing the installation of add-on expansion cards. Such cards give the computer new abilities or otherwise improve operations. The slot is actually an outlet on the motherboard providing a direct connection between the computer's bus, or main data pathway, and the expansion card. Expansion cards must be made to fit the various types of expansion slots. The main types of expansion slots are Video Electronics Standards Association Local Bus (VL-bus), Industry Standard Architecture (ISA), Extended Industry Standard Architecture (EISA), and Peripheral Component Interconnect (PCI). See **expansion card**. See **Industry Standard Architecture**. See **Peripheral Component Interconnect**. See **Video Electronics Standards Association**. See **Local Bus**.

expert system—Considered a form of artificial intelligence (AI); this is an application that makes decisions by using facts, rules, and a reasoning ability called an inference engine. The facts are supplied by human experts in a particular field. Common categories include medicine, investments, automobile routing, insurance, equipment repairs, and science. Users query, or ask a question, of the expert system. It then comes up with an answer according to the facts and rules with which it has been programmed and explains its results. These results may sometimes be a little skewed by a computer's "black-or-white" approach to reasoning. Also called rule-based system.

Explode—To restore compressed data back to its original form. See **unzip**.

export—To transfer data from one computer to another or one application to another. Before a file is exported, the computer or program must change the file to a format usable in the other computer or program. Many desktop publishing, word processing, and graphics programs will include an Export command allowing the user to select a format for the exported file. Compare to **import**.

expression—A combination of symbols and letters representing an operation or value in computer programming. Expressions may be strings of characters and symbols, such as "Jane Doe," or numeric phrases, such as 2 + 3. Expressions of symbols and letters also might be used in a database to search for data or in a spreadsheet to perform calculations. An expression differs from an action statement, which performs an action instead of designating a value.

extended ASCII—While the regular ASCII uses seven bits to code characters (equaling 128 characters), extended ASCII uses eight bits, adding another 128 characters. The original ASCII defined the codes for the average letters and numbers used by computers. Extended ASCII defined extra characters, such as special symbols, foreign language letters, or drawing characters. See **American Standard Code for Information Interchange**.

Extended Binary Coded Decimal Interchange Code (EBCDIC)—A coding method used by larger computer systems to present letters, numbers, and other symbols in a binary language the computer can understand. Codes can be made of eight bits of information, allowing for 256 possible character codes. EBCDIC was first developed by IBM. The coding used by most PCs and microcomputers, however, is ASCII. See **American Standard Code for Information Interchange**.

IBM Extended Characters (Extended ASCII)

Dec.	Char.	Dec.	Char.	Dec.	Char.	Dec.	Char.	Dec.	Char.	Dec.	Char.	Dec.	Char.	Dec.	Char.
128	Ç	144	É	160	á	176	4	192	@	208	P	224	α	240	≡
129	ü	145	æ	161	í	177	7	193	A	209	Q	225	β	241	±
130	é	146	Æ	162	ó	178	9	194	B	210	R	226	Γ	242	≥
131	â	147	ô	163	ú	179	3	195	C	211	S	227	π	243	≤
132	ä	148	ö	164	ñ	180	4	196	D	212	T	228	Σ	244	⌠
133	à	149	ò	165	Ñ	181	5	197	E	213	U	229	σ	245	⌡
134	å	150	û	166	ª	182	6	198	F	214	V	230	μ	246	÷
135	ç	151	ù	167	º	183	7	199	G	215	W	231	τ	247	≈
136	ê	152	ÿ	168	¿	184	8	200	H	216	X	232	Φ	248	°
137	ë	153	Ö	169	⌐	185	9	201	I	217	Y	233	Θ	249	∙
138	è	154	Ü	170	¬	186	:	202	J	218	Z	234	Ω	250	·
139	ï	155	¢	171	½	187	;	203	K	219	[	235	δ	251	√
140	î	156	£	172	¼	188	<	204	L	220	\	236	∞	252	η
141	ì	157	¥	173	¡	189	=	205	M	221	]	237	φ	253	²
142	Ä	158	₧	174	«	190	>	206	N	222	^	238	∈	254	■
143	Å	159	ƒ	175	»	191	?	207	O	223	_	239	∩	255	

extended capabilities port (ECP)—A parallel port standard developed by Microsoft Corp. and Hewlett-Packard for a high-speed port that allows communication back and forth between the computer and the peripheral. Another, similar type of parallel port is the enhanced parallel port (EPP). The parallel port types do not differ in size, just in how they operate. See **enhanced parallel port**.

Extended Data Output RAM (EDO RAM)—A type of RAM memory chip that features a performance increase of up to 10% over normal dynamic RAM. To achieve the faster speed, the computer's memory controller must be built to recognize EDO chips. EDO RAM will work with a standard memory controller, but the speed gain will not be realized. The faster memory read speeds are achieved by keeping the chip output buffer active longer than with normal RAM. See **random-access memory**.

extended graphics array (XGA)—IBM's upgrade to the VGA video card. With a resolution of 1,024 horizontal pixels by 768 vertical pixels and 256 colors, it is a proprietary standard that works only on IBM systems. See **pixel**.

Extended Industry Standard Architecture (EISA)—Known as Extended ISA, sometimes pronounced "eesah." The standard for an IBM-compatible computer data bus that can transfer 32 bits of data at a time. The Extended ISA was developed by a consortium of nine IBM competitors as a response to IBM's Micro Channel Architecture (MCA) bus. Unlike MCA, EISA is fully backward-compatible with the older 16-bit Industry Standard Architecture (ISA) bus. Neither MCA or EISA really ever caught on. Today's Pentium PCs often feature a combination of ISA expansion card slots and the newer Peripheral Component Interconnect (PCI) slots. See **expansion card**. See **expansion slot**. See **Industry Standard Architecture**. See **Micro Channel Architecture**. See **Peripheral Component Interconnect**.

extended memory—The name for all memory above the first MB. Extended memory is usually unavailable to DOS programs under normal circumstances because most DOS programs are formatted to use conventional memory. It is available to Microsoft Windows programs (when the computer is operating in a protected or virtual real mode), and can be used by RAM disks or disk caches. The expanded memory manager allows extended memory to act as expanded memory. See **conventional memory**. See **expanded memory**. See **random-access memory**.

extended memory specification (XMS)—Determines how a 286-based or higher computer can use extended memory and the high memory area in DOS, requiring the use of the expanded memory manager (EMM) driver. Extended memory extends the operating system's (OS) reach beyond the first MB of memory, while the high memory area is the first 64KB of that extended memory. It was originally developed by Microsoft Corp., Intel Corp., AST Research, and Lotus Development Corp. See **expanded memory manager**. See **extended memory**. See **high-memory area**.

extended technology (XT)—The full name for the first IBM PC that contained a hard drive. It was introduced in 1983.

extended video graphics array (extended VGA)—See **super video graphics array**.

extension—See **file extension**.

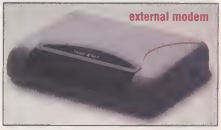
extent—When referring to hard drives and other storage media, a contiguous block of space the operating system (OS) has designated to store a specific file or application.

external command—A DOS command not included in the Command.com file, which is the DOS file that tells the computer how to respond to most commands presented. A command that is excluded from Command.com because its definition is too lengthy. A few examples are Format.com, Diskcopy.com, and Chkdsk.com (or Chkdsk.exe, depending upon the DOS version in use). Internal commands, on the other hand, include the relatively simple DIR and COPY. Compare to **internal command**.

external function (XFCN)—A function or task created by the user or developer that is not available in the original program.

external icons—User-created or non-Windows icons. See **icon**.

external LAN adapter—An external unit, usually in the form of a PC Card, that plugs into a PC Card socket on a portable computer in order for it to connect to a local-area network (LAN). The only requirement is that the adapter be compatible with the network's topology and the computer has the proper network software and operating system (OS). See **local-area network**. See **PC Card**.



external modem—A modem externally attached to the computer, usually through a serial port, with its own power supply. An external modem operates like an internal modem, although it can be shut off without powering down the entire computer if something goes wrong. External modems are more expensive than internal modems, but they are easier to install. See **modem**. See **serial port**.

external storage—Any type of computer storage not included in the computer's main memory. Any hard drive, diskette, tape drive, or other similar device is an external storage unit. See **storage**.

extranet—A controlled-access network that uses Internet technology to share public information but keep private information secure. Usually an extranet is part of a larger intranet (an inter-office network also using Internet technology). For example, a company with an intranet could make some services on that network publicly visible on an extranet. Prime candidates for positions on an extranet are Web servers and ordering systems. All other parts of the network would be off-limits and unreachable to outsiders. Firewalls are typically used to provide such protection. See **intranet**. See **firewall**.

extremely low frequency emissions (ELF emissions)—One of the magnetic emissions given off by computer monitors. It is unknown if such emissions are harmful to humans who encounter them near common appliances, such as hair dryers. To regulate these emissions, the Swedish government created the MRP II standard for computer monitors. Monitors meeting this standard give off very low ELF emissions.

E

e-zine—Short for electronic magazine. The term can refer to a variety of online journals, some are Web sites and mailing lists. E-zines take advantage of the low publishing costs of the Web. E-zines aren't always exclusively Web-based, however, since there may be print versions of the same content available.

F

F connector—A type of round, screw-on cable connector most often seen with coaxial cable. See **coaxial cable**. See **storage**.

F key—See **function keys**.

F1, F2, . . .—See **function keys**.

face—See **typeface**.

facsimile—See **fax**.

fail-safe system—A system protected from breaking down under any circumstances. In reality, many computer systems are built to be merely "fault tolerant" because it is too expensive to make a system completely fail-safe. A common way of making something fail-safe is to duplicate the parts most likely to fail.

fail-soft system—A computer system designed to shut down nonessential components in the event of a failure, but keep alive important functions, such as keeping information safe in memory, as long as possible or until the problem is repaired.

failure—A situation in which a computer cannot continue to perform as designed. Failures are caused by power fluctuations, misuse, poorly manufactured or designed hardware or software, and other calamities.

fan—An air circulating device inside a computer case that cools heat-generating components. Basically, it is a small version of fans used to move air in buildings. Usually, these fans are built into the power supply of a computer.

fan-fold paper—A type of paper used in continuous-feed printers. The paper comes in one long sheet, perforated and folded into stacks. Tractor-feed fan-fold paper includes perforated, hole-punched strips on either side of each page for the printer to grab. After the paper is pulled or pushed through the printer, it can be torn into sheets.

FAQ—See **frequently asked questions**.

Fast AT Attachment ATA—See **Enhanced Integrated Drive Electronics**.

fast boot Basic Input/Output System (fast boot BIOS)—A component of the BIOS chip that essentially helps the computer contact the necessary software—usually the operating system, which runs most of the other commonly used programs—and reboot itself. See **Basic Input/Output System**. See **boot**.

fast boot BIOS—See **fast boot Basic Input/Output System**.

fast Ethernet—A communications protocol enabling computers on a local-area network (LAN) to share information with one another at rates of 100 million bits per second (bps). Standard Ethernet connections run at 10 million bps. See **local-area network**.

fast IDE—See **Enhanced Integrated Drive Electronics**.

FAT—See **file allocation table**.

FAT32—A 32-bit version of the file allocation table (FAT), which is used to keep track of the contents of a disk. FAT32 lets users store more data on hard drives and use bigger drives. The previous version of FAT, FAT16, used 16 bits to address clusters, which limited the size of hard drives to 512 megabytes (MB), or two gigabytes (GB) if the drive were partitioned into four 512MB partitions. FAT32 supports drives as big as two terabytes (TB). FAT16 uses 32 kilobyte (KB) clusters to store data, while FAT32 uses only 4KB. This saves space, since a 33KB file in FAT16 requires two 32KB clusters or 64KB of disk space, while the same 33KB file in FAT32 requires only nine 4KB clusters, or 36KB of disk space. FAT32 also offers more reliability than FAT16 because it can use a backup copy of the file allocation table in case of a disk error or failure. FAT32 was incorporated into Windows 95 starting with computers shipped in late 1996. It is not available as an upgrade to Windows 95; users who do not already have the feature will need to buy Windows 98. See **file allocation table**.

fatal error—An error that causes an operating system (OS) to crash. See **crash**. See **operating system**.

fault—A malfunction. Most often refers to glitches in a network system but also can refer to individual computers.

fault tolerance—Allows a computer to suffer some types of faults without losing data. Operating systems, such as Windows, have some of these capabilities built into their architecture, although they do not always work.

fault tolerant system—A computer system designed to suffer certain types of faults or errors without losing data.

fax—The transmission of graphics or text across telephone lines. Faxes can be sent and received from fax machines, but the trend is to use fax/modems, which can digitize information from an application, such as a word processor, and send it to any fax machine or fax/modem on any type of computer. Also called telecopying or facsimile. See **fax/modem**.

fax broadcast—Sending a single fax document to many people at once. Many fax programs let the user schedule fax broadcasts for off-peak times to save on long-distance telephone fees.

fax/modem—A communications device that allows a PC to fax documents and send

data to other modem-equipped PCs. Fax documents can be sent directly to fax machines or from computer to computer and appear on-screen rather than printed on paper. See **fax**.

fax-on-demand—With fax-on-demand software and a fax/modem, a company can setup a system in which callers use TouchTone phones to request particular faxes offered by the company. Some computer hardware and software companies provide answers to frequently asked questions in this format. Also known as fax retrieval. See **fax/modem**.

fax retrieval—See **fax-on-demand**.

fax server—A computer dedicated to sending and receiving faxes for a group of networked computers. Faxes come into the server over telephone lines and are stored on a hard drive or sent to the appropriate recipient over the network. Fax servers are also used for fax-on-demand services. See **fax-on-demand**.

FCC—See **Federal Communications Commission**.

FCN—See **function**.

FDD—An acronym for floppy disk drive. See **diskette drive**.

FDDI—See **fiber distributed data interface**.

FDHD—Floppy drive high density. See **SuperDrive**.

FDISK—(Pronounced eff-disk.) A DOS command that starts the fixed disk configuration program. The program configures a hard drive for DOS use. It can be used to partition a hard disk into what the computer reads as multiple hard drives. See **fixed disk**. See **partition**.

feather—In graphics, an effect that causes an image to soften at its edges to blend with the background.

feature—A desirable or notable aspect of an application or piece of hardware. For example, a built-in dictionary of financial terms is a feature of a personal finance manager; a voice-recognition program is a feature of a multimedia kit.

Federal Communications Commission (FCC)—This U.S. government agency regulates interstate and international communications; which includes telecommunications. The FCC was created by the Communications Act of 1934 to regulate the use of airwaves for broadcast transmissions. With the proliferation of the Internet, online services, and Internet telephony, the FCC has been forced to also take on computer-related communications.

feed—To continuously input materials or data into a computer or other machine. A data entry worker, for example, can feed numbers into a database. Paper can be fed into a printer.

feedback—Routing part of an output signal back to the input of the device. This occurs, for example, when sounds from a speaker make their way back to a microphone, causing a loop that builds quickly to a high-pitched squeal. Feedback is useful in some machines for regulating output.

feeder cable—Usually a bundle of cables carrying telephone communications. Used to describe many large wire bundles of different types.

female connector—Any cable connector that includes a receptacle or receptacles for pins from the opposite, male connector. Compare to **cable connector**. Compare to **male connector**.

ferric oxide (FeO2)—A material used to make magnetic data storage media, such as 3.5-inch and 5.25-inch diskettes. Ferric oxide coats the floppy Mylar diskettes protected by the diskettes' plastic sheath. It helps data magnetically stick to the Mylar. Ferric oxide is also known as iron oxide or iron (II) oxide (pronounced "iron two oxide").

fetch—The act of retrieving a bit of information from memory and putting it in a microprocessor's register. This is a basic function of a computer. See **bit**. See **register**.

fiber distributed data interface (FDDI)—A standard developed by the American National Standards Institute (ANSI) for fiber-optic networks. FDDI uses fiber-optic cable to transmit data in bursts of light at speeds far faster than conventional networks. Rates of 100 megabits per second are possible over distances of two kilometers or less. See **fiber optic**.

fiber optic

fiber optic—Hollow, strand-like cables that carry pulses of light to transmit digital information. Long-distance telephone lines are made of fiber-optic cables, and fiber optics might make up a large part of the circuit systems of computers one day. Fiber optics is faster than standard electronics because transmissions travel at the speed of light. A single fiber-optic strand can carry far more independent streams of data than is possible with wire cables.

FidoNet—A network of BBSes that can exchange E-mail and other files based upon a protocol developed in the mid-1980s by the system operators of the original BBS software, Fido. One of the best things about FidoNet is that local bulletin boards can contain messages and files from local users as well as those appearing on bulletin boards in other parts of the world. In 1996, FidoNet included more than 11,000 nodes and connected to the Internet.

field—An individual item of information in a database. A field might contain a mixture of characters: letters, words, and numbers. For example, an automobile manufacturer might use a database to keep track of customers. A field in this database might contain the name, address, phone number, and account number of an individual who had recently purchased an automobile. Many fields combined are called a record. Compare to **record**.

FIFO—See first in, first out.

file—Information stored as an organized series of bits so it can be recognized by computer software. Not all files can be used by all software. Files can be parts of a program or used by data programs. Files are recognized by special names. See bit. See file name.

file allocation table (FAT)—The method Microsoft DOS (MS-DOS) uses to keep track of the contents of a disk. The table is a chart of numbers that correspond to cluster addresses on the disk. When users or programs request a file, DOS searches from address to address in the FAT to find where a file's clusters are stored on disk. It then goes to the disk to collect each cluster of information.

file attribute—Flags associated with files used by DOS to keep tabs on which files are hidden, which are system files, and which are ready to be included in the next general disk backup. Applications often automatically change file attributes. See flag. See hidden files. See system file.

file backup—See backup.

file compression—See data compression.

file conversion—The process of changing the format of a file from one standard to another. For example, to look at Microsoft Word documents with WordPerfect, it might be necessary to convert the Word documents into the format of WordPerfect documents. Many applications can convert documents, graphics, databases, and other programs of rival brands into their own format for viewing or editing. A variety of third-party products also performs such conversions between different formats.

file extension—A "tag" that can serve as an additional identifier for a file beyond the file name. Separated from the rest of the file name by a period, the file extension can be used to indicate whether the file is an executable program (.EXE), a data file (.DAT), and so on. File extensions are an optional part of file names. In DOS and Windows, file extensions are always three letters long. Different programs will attach different extensions to the files they create. For example, Microsoft Word creates files with the .DOC (document) extension. PageMaker 6.0 uses the .PM6 extension. (See chart on following page.)

file format—The way data is organized for a particular kind of file. Some formats are proprietary and can be read only by the program used to create the file. Other formats, such as the ASCII and rich text format (RTF), are more generic and can be read by many programs. File filters convert files from one format to another. If a file is in the wrong format to be read by a particular program and the program is not capable of file conversion, the file may be unreadable. See American Standard Code for Information Interchange. See file. See filter. See rich-text format.

file fragmentation—A situation in which parts of a file are scattered around many different sectors of a diskette or disk drive. A computer keeps track of the location of all segments, but tracking them down can slow read/write operations. Operating systems (OSes) such as DOS and Windows come with utilities to defragment drives when they become overly fragmented. See defragmentation.

file handle—A temporary name assigned to an open file by the operating system (OS). During the time the file is in use, the OS can access the file through the handle. Users normally do not have access to these handles. See operating system.

file header—See header.

file layout—The arrangement of data records in a file such as a database.

file maintenance—The performing of certain routine changes, updates, copying, moving, or deleting in a file or files by a person or an automatic computer program. Also known as file management.

file management—See file maintenance.

File Manager—A program included with Windows that lets users view the contents of a storage medium, usually hard drives, CD-ROM drives, and diskettes. File Manager includes, among other capabilities, ways for users to move, delete, copy, and rename files and create, view, and remove entire directories.

file name—A complete title for a particular file. A file name includes a name and possibly an extension. For example, in the file name Letter.txt, "Letter" is the file name and ".TXT" is the extension. Files used by Windows 3.11 and older and Microsoft DOS (MS-DOS) programs require file names of eight letters or numerals plus an extension. The extension designates the format of the saved file and often the program in which it was saved. Windows 95 allows file names much longer than eight characters. The two sections are separated by a period or dot (for example, Filename.ext). Except for dashes, the name can contain no other punctuation. See file extension.

file not found—An error message returned by operating systems (OSes), such as DOS or Windows, when the user requests to load, save, delete, or otherwise manipulate a file that the computer is unable to locate. This might happen if a file has been accidentally deleted, if it resides on a diskette no longer available to the computer, or if a storage medium such as the hard drive has been damaged.

file path—See path.

file protect ring—A plastic ring used to protect magnetic tape files. See safety ring.

file protection—A preventative safeguard against unwanted changes or additions to a file. One common way to protect a file is to set it to "read-only" status, which means it can be viewed but not altered. Word processing programs allow files to be opened in a read-only mode.

file recovery—The process of rebuilding lost files from a diskette or hard drive after a malfunction or deletion. Usually, files are not entirely deleted from a hard drive or diskette, and unless the file location on the diskette where the file once was has been overwritten with new data, a variety of utility programs can be used to recover at least some, if not all, of the data. File recovery also can refer to restoring files from a backup tape or diskette.

Common File Extensions & Application Associations

.2GR—Allows Windows to display text and graphics when running in Standard mode on a 286 or 386 computer.

.3GR—Allows Windows to display text and graphics when running in En-hanced mode on a 386, 486, or Pentium computer.

.386—Files, also called swap files, that help computers running in Enhanced mode use Windows with virtual memory.

.ARC—Files compressed with the ARC format; won't work with *PKUNZIP*.

.AVI—Movie files for use with the Windows Media Player.

.BAK—Backup files, usually created during program installations for the Autoexec.bat and Config.sys files.

.BAT—Batch files mainly used in DOS.

.BMP—Bit-mapped files used for graphics, such as Windows wallpaper.

.CAL—Files used with the Windows Calendar program.

.CBT—Tutorial files usually used with Microsoft programs.

.CFG—Files used to store information for MIDI components.

.CHK—Files recovered using the CHKDSK command in DOS. When a program crashes, CHKDSK sometimes recovers the unsaved information in a file with a .CHK extension.

.CLP—Files used with the Windows Clipboard program.

.COM—Command files mainly used in DOS.

.CPL—Files used with Windows Control Panel components.

.CRD—Files used with the Windows Cardfile program.

.DAT—Data files used by programs to store information.

.DEV—Device driver files (also .DRV).

.DLL—Dynamic-link library files that help Windows programs operate smoothly.

.DOC—Word processing document files; many programs use this extension, most notably *Microsoft Word*.

.DRV—Device driver files (also .DEV).

.EPS—Files containing information designed for PostScript printers.

.EXE—Program files; they actually run a particular program. The majority of DOS programs and nearly all Windows programs use .EXE files.

.FON—Font files used with non-TrueType-compatible fonts. They are used with error messages or menus generated by Windows.

.FOT—TrueType font files; they must be combined with a similarly named .TTF file to create a TrueType font.

.GIF—Graphics and picture files in a compressed format. Paintbrush can't view .GIF files; a standalone graphics program is required to view them.

.GRP—Files used with program groups in the Windows Program Manager.

.HLP—Help files that provide information.

.ICO—Files representing icons.

.INF—Files that provide information required by programs during installation; you cannot edit these files.

.INI—Initialization files containing text used by Windows to recall specific options in your computing setup; users can edit these files. Each Windows program usually has its own .INI file.

.JPG—Picture files. Paintbrush can't view these files; a standalone graphics program is required.

.MID—Sound files that contain musical notes.

.MPG—Movie files. Media Player can't view these files; a standalone video program is required.

.MSP—Files used with the Windows Paint program, which was the predecessor to Paintbrush; used with Windows before version 3.0.

.NET—Network files.

.OVR—Overlay files that are small parts of larger programs.

.PAL—Sometimes used with the Windows Paintbrush palette file.

.PAR—Permanent swap files for Windows.

.PCX—Files used with Windows Paintbrush.

.PIF—Program Information Files that give Windows instructions for handling DOS programs.

.PIX—Graphics files.

.REC—Macro files used with Windows Recorder.

.RLE—Picture files. Paintbrush can't view these, but they can be used as wallpaper in Windows.

.RTF—Files that allow standalone word processing files to exchange text while retaining coding.

.SCR—Screen saver files.

.SRC—Files used in creation of .INI files.

.SWP—Temporary swap files for Windows.

.SYD—A backup file automatically created when you edit a file using Windows Sysedit.

.SYS—System files.

.TMP—Temporary files. Windows sometimes creates these files but fails to delete them. You can safely delete them when Windows is not running.

.TRM—Files used for Windows Terminal settings.

.TTF—TrueType font files; they must be combined with a similarly named .FOT file to create a TrueType font.

.TXT—Text files usually created by Windows Notepad.

.VOC—Sound files. These won't work with Media Player or Sound Recorder; usually used with DOS sound boards.

.WAV—Sound files that work with Media Player and Sound Recorder.

.WIN—Windows backup files.

.WPD—Files containing information for use with PostScript printers.

.WRI—Files used by the Windows Write program.

.ZIP—Files compressed with the *PKZIP* program and requiring PKUNZIP program for decompression. □

file server—A computer on a local-area network (LAN) that provides network users access to shared data and program files. A file server is sometimes a standard PC, but also can be a dedicated system with fast microprocessors and large hard drives designed for use as a file server.

file sharing—Multiple computers accessing the same information residing in the same location, often over a network. Some types of access, such as the ability to change or delete a file, may be limited to certain users through the use of passwords or other protection schemes.

file size—A measure of the space a file takes up on a storage medium or in computer memory. File sizes are usually measured in bytes (B), kilobytes (KB), or megabytes (MB), though they can be measured in gigabytes (GB), terabytes (TB), and larger measurements.

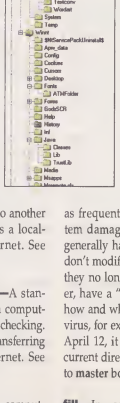
file system—Used to organize and retrieve files from a storage medium such as a hard drive. File systems consist of files separated into groups called directories. Directories can contain subdirectories, which in turn can contain still more subdirectories.

file transfer—The act of moving data that makes up a computer file from one storage medium or location to another. File transfer also can describe moving a file from one computer to another computer over a network such as a local-area network (LAN) or the Internet. See **local-area network**.

File Transfer Protocol (FTP)—A standard way to transfer files between computers. The method has built-in error checking. It is frequently used as a way of transferring many types of files over the Internet. See **anonymous File Transfer Protocol**.

File Transfer Protocol site—A computer, usually connected to the Internet, that offers files to others through anonymous File Transfer Protocol. See **anonymous File Transfer Protocol**.

file system



file type—A label designating a file as a certain kind. Various applications save data in certain formats recognizable to those applications. For instance, Microsoft Word saves files in Microsoft Word format, which means those files will have a .DOC extension in DOS and Windows. See **file extension**.

file viewer—Software that displays the information stored in a file. For example, the Windows Notepad can display text files. Some file viewers display files in more than one format. A graphics program might recognize graphics interchange format (.GIF) images as well as bit-mapped (.BMP) images. A word processor might be able to display numerous storage formats for documents, but some programs are specifically made to display a wide variety of formats. Some file viewers allow the user to edit files, others only allow viewing.

file virus—A type of file that infects individual files, as opposed to a master boot record (MBR) or memory. File viruses generally infect operating system (.SYS) files, executable (.EXE) files, or command (.COM) files. The viruses usually attach themselves to the beginning or end of the file and remain inactive until the file is loaded. Then, the file and the virus are loaded into memory. Once there, it can infect other files. Damage from viruses can be as slight as lost disk space or as serious as frequent system crashes, operating system damage, or lost data. File viruses are generally hard to spot because they usually don't modify programs or files so much that they no longer work. Some viruses, however, have a "damage routine" that tells them how and what files to damage. The Arcv-Fri virus, for example, will check the date. If it's April 12, it searches for a .COM file in the current directory, then damages it. Compare to **master boot record**.

fill—In a graphics program, to fill an area is to change its color. In a spreadsheet program, the fill command is used to quickly copy formulas or values from one cell to another or to many others.

filter—A computer program that reads data in a standard way, but transforms it to fit another output pattern. For instance, when a Microsoft Word document is saved as a WordPerfect document, a filter is used. Graphic design applications provide filters to alter the look of all or part of an image.

find—Refers to an application program or command that locates a specific file or files with specific characteristics from a group of files stored in several locations. Many word processors, for instance, lets users locate documents created at a certain time, containing keywords or possessing other attributes. Such capabilities are also built into many operating systems (OS). Inside an application, the find command can locate a particular word or character string in a document. See **search**.

Finder—In older Apple Macintosh systems, the Finder was the user interface portion of the system software. Finder has been replaced by MultiFinder. See **user interface**.

finger—A program used mainly on the Internet to find information about particular users. If an Internet service provider's (ISP) system is configured to use a finger program, typing finger username@host .domain at a Unix prompt brings up a user's real name, regardless of whether the user is even logged on, and other information. Many systems block access to outside finger requests.

firewall—Software or hardware that limits certain kinds of computer access from a network or other outside source. Firewalls are used to thwart would-be hackers from infiltrating computer systems. See **hacker**.

FireWire—See IEEE 1394.

firmware—A program stored in a computer's ROM or elsewhere in a computer's circuitry. Firmware programs remain even when the computer's power is turned off. They usually deal with basic computer functions, such as the boot-up process. One example is the BIOS. Unlike software, firmware cannot be changed by the user. See **read-only memory**.

first in, first out (FIFO)—Processing data in the order in which it is received.

first-line indent—An indent or tab on the first line of a paragraph. See **indent**.

fixed disk—Used interchangeably with the terms hard disk and hard drive. Hard drives are magnetic storage devices that typically contain several gigabytes (GB) of information. Most hard drives are not designed to be removed from the computer.

fixed-frequency monitor—A computer display monitor that will only run from a certain type of signal within a limited frequency range. Compare to **multiscanning monitor**.

fixed-length field—In a database or other data file, fixed-length fields contain data of a predetermined size. For instance, a field meant to hold the date a record was entered may only have space for eight characters, which is enough to hold data such as 04/29/90. Compare to **variable-length field**.

fixed-point notation—A format for writing numbers in which the decimal point is in a specific, fixed location such as 156453.34, 5.32, and 0.42. Compare to **floating-point notation**.

fixed storage—A storage medium not meant to be removed from its location, such as a hard drive inside a computer.

fixed-width font—See **monospacing**.

flag—A bit of information able to be in one of two possible states, which can be thought of as "on" or "off." Sometimes software is designed to perform a certain action on files with a particular flag set to the "on" or "off" position. For example, DOS files include an archive attribute or flag that indicates if the file has been changed since a backup was last performed. If the flag is set to "on," indicating the file has changed, special backup software can be configured to back up that particular file but leave files alone that are unchanged.

flame—An argumentative newsgroup posting or electronic mail (E-mail) message in response to another posting or message. Flames range from satirical witticisms and sarcasm to vicious name-calling. Often, a flame attracts other flames in return, leading to what is called a flame war. Flaming is most often seen in Usenet newsgroups, a bulletin board-like area of the Internet.

flame war—See **flame**.

flash BIOS—A BIOS stored in flash memory. BIOS is the essential software built into a computer to handle the performance of basic recurring tasks. Flash memory is easier to upgrade than ROM, the original method for holding the BIOS. Upgrading a ROM BIOS requires replacing a chip, but flash memory can be upgraded electronically. See **Basic Input/Output System**. See **flash memory**. See **read-only memory**.

flash erasable programmable read-only memory (EPROM)—(Pronounced ee-prom.) A type of EPROM, a rewriteable chip, that is easier to use and erase than the standard version. See **erasable programmable read-only memory**.

flash memory—A type of computer memory developed by Intel Corp. Flash memory is integrated circuit (IC) memory that does not need continuous power to retain the data stored in memory. It is expensive compared to magnetic storage and is therefore not practical as a replacement for current hard drives or diskettes. It sometimes is used to store computer BIOS and startup data. See **integrated circuit**.

FlashSession—A feature of the commercial online service America Online (AOL) that allows a computer to automatically sign on to the service, send and retrieve electronic mail (E-mail) and other data, and then sign off. FlashSessions save a user online charges because they are the fastest way to sign on and check frequently accessed departments such as E-mail. See **electronic mail**.

flash storage—See **flash memory**.

flat file—A data file that does not contain links to other files. This term is often used in reference to non-relational databases. Relational databases let the user define relationships between databases. See **relational database**.

flat-file database—A database without a defined relationship between data files, as there is in a relational database. Compare to **relational database**.

flat-panel display—Lightweight, thin screens used in portable computers and, more recently, in flat-panel monitors. Liquid-crystal display (LCD) technology is used for flat-panel displays instead of cathode-ray tubes (CRT), which are used in standard monitors. Flat-panel displays are more expensive to

flat-panel display

manufacture than standard displays and can increase the cost of a portable computer. See **cathode-ray tube**. See **liquid-crystal display**.

flat screen—A computer monitor with a display screen that has less curvature than the screens of most monitors. Flat screens generally give off less glare and have less image distortion than spherical monitors. Cylindrical screens, such as those built around Sony's Trinitron tube, are flat from top to bottom but are curved from side to side. Compare to **flat-panel display**.

flatbed plotter—A computerized plotter in which an arm moves a pen over paper rather than having the paper move under the arm as with a drum plotter. Plotters are often used to print large diagrams. Compare to **drum plotter**.

flatbed scanner—See **optical scanner**.

flexible disk—See **diskette**.

flicker—A shimmering phenomenon of an on-screen image caused by rows of monitor pixels going on and off. Severe flicker can cause eyestrain. See **pixel**.

flight simulator—A computer game that simulates the environment of a pilot in

flight simulator

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control of a flying machine such as an airplane or spaceship.

floating defects—A problem on a fixed disk that suddenly appears because of the drifting alignment of the drive's read/write heads. Such defects may not have been noticed previously because they were located between tracks. As with many drive problems, the computer can keep track of their locations and avoid using those portions of the drive through programs such as ScanDisk. An attempt to write data to defective areas of the drive can result in lost information. See **fixed disk**. See **head**.

floating-point coprocessor—An additional processor inside a computer that works with the central processing unit (CPU) to perform the many calculations necessary for running programs. Floating-point coprocessors are designed to perform calculations using floating-point notation, which can speed up graphics and other math-intensive tasks. Some systems that do not include floating-point coprocessors, such as those built around Intel Corp.'s 80386SX microprocessor, do let users add the floating-point coprocessor later if they desire. See **floating-point notation**. See **floating-point operation**.

floating-point notation—A method of storing numeric calculations where the decimal point is not in a fixed location. Floating-point notation includes the digits of a number (called the mantissa) and an exponent. For instance, an extremely small number such as 0.000023 can be written as 23E-6. A large number like 23,000,000 can be written as 23E6. Floating-point processors are designed to perform calculations using this type of shorthand notation. Floating-point processors can speed up the production of graphics and other tasks. See **floating-point coprocessor**.

floating-point operations per second (FLOPS)—A measure of the number of floating-point operations a microprocessor can perform in one second. See **floating-point notation**.

floppy disk—See **diskette**.

floppy disk controller—See **diskette drive**. See **controller**.

floppy disk drive—See **diskette drive**.

floppy diskette—See **diskette**.

FLOPS—See **floating-point operations per second**.

floptical—A special type of diskette manufactured by Insite Peripherals Inc. This diskette stores data magnetically like a standard diskette, but uses a special optical track to help align the read/write head of the 3.5-inch diskette drive. Flopticals can hold 21MB of information. See **head**.

flow control—In communications, this is the management of traffic between two devices. Flow control ensures that data is sent at the best possible rate—not so fast that the receiving end can't keep up, but not so slow that it's sitting idle. Flow control is especially useful when a high-speed device is communicating with a much slower device. One of the most common forms of flow control is the Xon/Xoff protocol, in which an Xoff signal is sent when a device's buffer is full and it can't receive any more information. After the buffer is cleared, an Xon signal is sent to signal the sending device to resume transmission. In programming, this is the order in which a program runs. Examples of flow control programming statements include "if-then," "for-next," and "while." For example, a program could contain a statement that tells it to prompt the user to insert a diskette if there is no diskette in the drive.

flowchart—A graphical representation of a series of decisions and their resulting effects in the order in which they might occur. Flow-charts make use of standardized symbols to break down complicated processes into individual steps.

flush left—Aligned with the left margin, side of a page, or side of a screen.

flush right—Aligned with the right margin, side of a page, or side of a screen.

FM synthesis—A method used by sound cards and computers to mimic musical instrument sounds through electronic means. FM synthesis sounds are easily recognizable as computer-generated, unlike wavetable synthesis (WAV) sounds, which are reproductions of actual instrument sounds. See **sound card**. See **wavetable synthesis**.

folder—On Apple Macintosh systems, an organized catalog of files and subfolders equivalent to the directories in a PC. Users can create and delete folders and sub-folders at will to organize their files. See **directory**.

folio—A printed page number, but not necessarily the exact physical location in a series of pages. For instance, a page designated as "10" in the folio could be the 12th actual page.

font—The design for a set of characters, which includes typeface, point size, and weight. Within the Helvetica typeface family, 12-point bold is one font, while Helvetica 14-point is another. See **character**. See **typeface**.

font card—See **font cartridge**.

font cartridge—A plug-in cartridge containing font information in ROM. Some brands of printers accept font cartridges, which enable the printer to use more fonts. See **read-only memory**.

font conversion—The process of changing document fonts to fonts that exist on the current computer. A document might be created on another machine with fonts not available to the current machine. Font conversion attempts to match these foreign fonts to similar existing fonts. See **font**.

font editor—An application that lets users design new fonts or modify existing ones. See **application**.

Helvetica
Helvetica
HELVETICA
Helvetica

font family

font family—All variations of a single typeface. For example, Arial, Arial Condensed, and Arial Bold belong to the same font family. See **typeface**.

font scaling—A special ability of some printers whereby the printer only needs the outline of a particular font to create it in any required size.

font size—The size of the characters of a specific font, usually measured in points. See **characters per inch**. See **point size**.

foo file—Slang for a temporary file.

footer—An area at the bottom of a document page that holds an element or elements common to several pages. Users can edit the footer of one page to change all pages. One common use of footers are page number fields.

footprint—Used by manufacturers to describe the size of equipment such as computers, hard drives, and printers. If a computer has a small footprint, it takes up a smaller amount of desk space.

force-feedback technology—A hardware standard and memory system that adds the sensation of touch to input and control devices such as mice, steering wheels, flight yokes, and joysticks. The hardware gives users the physical sensation of what they are seeing on their computer monitors. It is frequently used with virtual reality situations and gaming to add a sense of realism.

forced page break—A command available in word processors that tells the application to begin a new page where normally there would not be a page break. For example, the last page of a chapter in a document might include a forced page break to tell the program to move to the next page and begin the next chapter, even though the current page is not full. See **page break**.

force quit—A command or key sequence that forces the computer to abandon its current operation and await further input from the user. A force quit is most often used to escape out of an error that has locked up a computer system. See **break**.

foreground—The foremost task or object on a computer system, in an application, or on a network. Foreground tasks are those the user is working on at the moment, which usually have access to more microprocessor time. Other tasks, those in the background, run slowly and receive less microprocessor time. In windows operating systems, the window on "top" of the other windows is said to be in the foreground. The term is also used in graphics applications, when some elements of a picture or layout lay on top of other elements. Compare to **background**.

form factor—The size of a device, in physical terms rather than capacity. It can be used to describe media sizes (such as 3.5-inch and 5.25-inch diskette drives), but is more often used to describe the size and layout of devices' cases. A form factor for a computer case or motherboard describes its dimensions as well as its layout, such as the location of hard drives, CD-ROM and diskette drives, slots, and ports. Form factors for computer cases and motherboards can have descriptive names, such as the Baby AT form factor for motherboards.

form feed—The button or command on a printing device that advances the paper or other media in the system one page forward, so new printing can begin on a blank page.

form letter—A document created mainly from standardized text but individualized with names, numbers, or other data. Most word processors can work in conjunction with a built-in or standalone database to automatically create a set of letters with the same body text but different addresses and names. The user types in the main letter text only once along with a list of names and addresses. The program combines the two to print a set of form letters. See **mail merge**.

FORMAT—A DOS command that prepares a blank diskette or hard drive to hold data. The FORMAT command will erase all data on a disk.

formatting—Preparing a diskette so it can store information. Formatting organizes the tracks and sectors that store information. Formatting a diskettes erases all previously stored information.

formula—An expression telling the computer which mathematical operations to perform upon a specific value. Formulas are most often used in spreadsheet programs. See **spreadsheet program**.

FORTH—A programming language developed in the 1960s. The name comes from the fact it was believed to be a fourth-generation language. See **programming language**.

FORTRAN—A computer programming language. The acronym stands for "formula translator." FORTRAN was one of the first programming languages, and forms of it are still used today in some technical, scientific applications. See **programming language**.

forum—An area on an electronic bulletin board or an online service where people with a common interest can post notes to one another. Forums are frequently used to ask questions, share information, or debate ideas.

forward-compatible—A piece of hardware or software designed to ensure compatibility with future versions of the same technology. For example, many 486-based computers were designed to accept future Intel Corp. OverDrive upgrade CPUs.

forward error correction—A method of transmitting data where special bits are transmitted before the data packets to ensure the link is free of errors. Because the system checks for errors before sending data, it can be slower than some other forms of transmission. See **data**.

forward slash—The name of the "/" character on computer keyboards. The forward slash is used in Internet addresses and parameters in DOS. Compare to **backslash**.

forwarding—The process of sending a message on to one or many electronic mail (E-mail) recipients. E-mail can easily be forwarded to another account, even in user-unfriendly Unix operating systems. Many online service providers offer ways to forward mail as well. IBM's Internet Connection service, for example, lets users set up E-mail message forwarding through a Web page. This term also applies to the networking process whereby a bridge, switch, or router moves data from an input port to the proper output port.

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four-color process

four-color process—A method of printing in which a color image is built by successively adding varying amounts of the four colors used in the printing processes: cyan, magenta, yellow, and black (CMYK). See **cyan-magenta-yellow-black**.

fps—See **frames per second**.

fractal compression—Compressing image files by converting them into mathematical equations. This method can provide amazing compression rates but it also can be very slow. See **data compression**.

fractals—One of three widely used ways (the other two are raster and vector) to convert graphics into data a computer can read and manipulate. Fractal images are converted to mathematical equations that describe the curves and other geometric features of the image. See **fractal compression**. See **raster**. See **vector**.

fragmentation—See **file fragmentation**.

FRAM—(Pronounced eff-ram.) A type of random-access storage that employs a special magnetic film. The beauty of FRAM is that it can store data for extended periods of time without being connected to a power supply.

frame—An edge or boundary surrounding a computer graphic. On World Wide Web (WWW) browsers, frames are defined areas that can act as multiple, separate browser windows within the same page. See **browser**.

frame buffer—A part of a computer's memory that holds the information necessary to display a single screen image.

frame capture board—An expansion board installed in a computer and connected to a video source, such as a laser disc player, a camcorder, a VCR, or a television cable or antenna. This works in much the same way as a VCR or antenna is connected to a television set. The frame capture board is then used to translate analog video images into digital video images that a computer understands. This process is called "digitizing" video. See **analog**. See **digital**. See **digitize**.

frame grabber—When a video signal is run through a computer, this specialized device captures the on-screen frame and converts it into an image that can be stored, viewed, and altered from inside the computer.

frame rate—The rate at which frames, or individual pictures, are updated in a video. Frame rate is usually measured in frames per second (fps). Motion in videos with high frame rates appears more fluid than videos with low frame rates. About 30fps is required to trick the human eye into seeing full motion. See **frames per second**. See **full-motion video**.

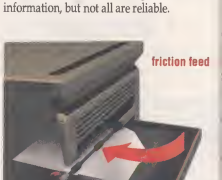
frames per second (fps)—A measurement of the speed at which a video switches from one frame to the next sequential frame to create the appearance of a moving image. See **frame rate**.

freenet—An Internet service provider (ISP) that is dedicated to providing free access to a group of people, who are usually in a specific geographical area. See **Internet service provider**.

freeware—Software available at no cost to the user. Often freeware is distributed through the Internet or dial-up modem connections. Compare to **proprietary software**. See **public domain software**. See **shareware**.

frequency—The number of oscillations in a current in one second, usually expressed in hertz. See **hertz**. See **oscillation**.

frequently asked questions (FAQs)—A list of questions and their answers, often found on the Internet, that address a particular topic. Some FAQs can be good sources of information, but not all are reliable.


friction feed

friction feed—A mechanism that allows standard, cut paper to pass through a printer. The paper is held in place by a roller or other device. Friction feed printers differ from tractor feed printers, which require special paper with punched holes that the printer can "grab." See **pin feed**.

friendliness—See **user friendly**.

front end—A graphical user interface (GUI) that makes another program easier to use. The front end replaces the original program's commands with simpler commands, menus, or icons. Microsoft Windows 3.1, for example, can be thought of as a front end for Microsoft Disk Operating System (MS-DOS). In a client/server database or network, a front end is a program that runs on a desktop PC and provides access data, documents, or programs stored on a back end "server" computer. Compare to **back end**.

front end processor—A computer that handles input and output communications for a larger mainframe computer, reducing the computer's load. See **mainframe**.

front panel—The front of a computer or another electronic device where the on/off switch, reset buttons, and other controls are often located.

frozen—The state of a computer when it appears to have stopped working, when nothing on the screen moves or can be changed by input from the keyboard, mouse, or other device. This "freezing up" usually is the result of an internal error by an application being run by the computer. If a machine is locked up it may need to be reset or rebooted for the user to regain control. See **reboot**.

fry—To damage an electronic component by allowing too much electrical current to pass through it.

FTP—See **File Transfer Protocol**.

full backup—Backing up, or saving, all files from one storage medium, usually the entire contents of a hard drive, to another medium. Some types of full backup media are magnetic tapes, optical discs, and removable hard drives. A full backup differs from a partial backup, incremental backup, and other backups because it includes every file regardless of whether the file was changed since the last backup. See **incremental backup**.

full pathname—See **path name**.

full-duplex transmission—The transmission of data in two directions simultaneously. Telephones are full-duplex devices, unlike most speakerphones, which are half-duplex. Half-duplex devices allow only one person to talk at a time. Most modems sold today are full-duplex. Also called duplex transmission. Compare to **half-duplex transmission**. Compare to **simplex transmission**.

full-motion video—Video playback in which individual frames are changed at a rate of at least 30 frames per second (fps). On a computer, video can play at various frame speeds depending upon system resources. At slower than 30fps, the image begins to appear choppy and not fluid to the human eye.

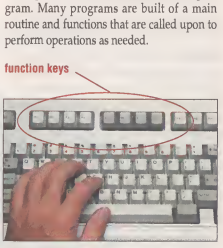
full-page display—A large computer screen that allows an entire 8.5-inch by 11-inch page to be shown at once, without the need for scrolling. A full-page display is particularly useful in desktop publishing (DTP). See **desktop publishing**.

full-screen—Occupying or being displayed across an entire computer screen. Full-screen video, for instance, is displayed on the entire screen rather than being contained in a small window. Full-screen video or other graphics may have to be enlarged to fit a whole screen, which can result in a lower-quality picture.

full-text search—Examines the entire text of files being searched for certain keywords or phrases. More limited searches might only look at titles, headers, authors, or other information.

function—A preset equation used to perform mathematical, financial, or statistical calculations in a spreadsheet or database.

function call—A request by a program to run a particular subroutine or another program. Many programs are built of a main routine and functions that are called upon to perform operations as needed.



function keys—Keys that act as shortcuts for performing functions such as saving files or printing data. Function keys are usually lined along the top of the keyboard and labeled F1 through F12, although some keyboards have fewer and others have more. Function keys also might be on either side of the lettered keys along the right or left edge of the keyboard. Function keys change their function depending upon which software is running, although the F1 key, for instance, often brings up a help screen.

fuse—An electronic element that automatically cuts a connection when too much current is allowed to pass through it. Fuses protect sensitive circuitry from overload.

fuzzy logic—Logic where answers do not need to be absolutely true or absolutely false but can have a range of probability. Fuzzy logic is used in artificial intelligence (AI) research and also is useful in searching programs that return probable matches from a database query along with sure matches. See **artificial intelligence**.

gallium arsenide (GaAs)—A compound found in microprocessors and memory modules. Gallium arsenide can process information several times faster, while consuming less power, than silicon, which is used in transistor chips and semiconductors.

game card—An expansion card designed specifically for improving the performance of games on a computer. The most common example of a game card is a joystick controller. Other cards support special controllers, such as flight sticks, steering wheels, and pedals. Game cards generally allow the use of more than the one joystick for which most computers have built-in support. Game cards usually support at least two joysticks and sometimes four. Many game cards also process the information from the joystick themselves instead of routing the input signal to the central processing unit (CPU). Some types of game cards support digital joysticks that offer better control and more control/firing buttons than the older, analog joysticks. See **card**. See **digital joystick**. See **expansion card**.

game control adapter—A port on IBM and IBM-compatible computers that lets users plug a joystick, yoke, or paddle into a computer. An analog-to-digital converter (ADC) in the adapter reads movements—up, down, right, left, and diagonal—on the gaming device and converts them to digital language a computer can understand. See **analog-to-digital converter**. See **joystick**. See **paddle**. See **yoke**.

gamma correction—Alteration of the brightness, contrast, and color of computer graphics in a printer, monitor, or scanner so graphics look uniform on a monitor screen or when printed.

G

game port

game port—A port built into virtually every Windows PC that connects game devices, such as joysticks, game pads, steering wheels, and flight sticks to the PC. The game port is a 15-pin socket are usually found on the sound card, but can also be found on game cards. Game ports are not the same as a serial port, which has only 9-pin sockets. See **game card**.

garbage in, garbage out (GIGO)—Refers to a computer's lack of reasoning ability. If incorrect data is put into a computer, it will produce incorrect results.

gas-plasma display—A flat monitor screen used on portable computers. The display is composed of a neon gas material between two layers of crisscrossing electrodes—one layer runs horizontally and the other runs vertically. The display charges the electrodes to create the pixels that form on-screen images. A pixel is "lit" when two electrodes that cross are charged. Also called a gas-discharge display or plasma display. See **pixel**.

gateway—A complex internetworking device that converts information from one protocol to another. Gateways transfer information between networks that use different communications protocols. The gateway actually deconstructs the information from one service and restructures it in the other network's protocol format. Gateways include all hardware and software used to link dissimilar network operating systems (NOS) or to link local-area networks (LANs) to mainframes or wide-area networks (WANs). Gateways also appear in electronic mail (E-mail) systems to convert messages between services that are using different E-mail protocols. See **communications protocol**. See **local-area network**. See **mainframe**.

Gb—See **gigabit**.

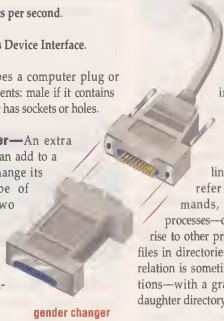
GB—See **gigabyte**.

Gbps—See **gigabits per second**.

GDI—See **Graphics Device Interface**.

gender—Describes a computer plug or port by its components: male if it contains pins and female if it has sockets or holes.

gender changer—An extra attachment users can add to a port or plug to change its gender. This type of device allows two male or female ports or plugs to connect. Also called sex changer and gender bender. See **gender**.



gender changer

general MIDI—(Pronounced mid-DEE.) This musical instrument digital interface (MIDI) is a standard used to create musical sounds with synthesizers and computers. General MIDI has 128 standard sounds that can be used on MIDI sound cards and other musical devices. See **musical instrument digital interface**.

General Protection Fault (GPF)—A warning in Windows operating systems (OSes) that a program has tried to reach a portion of memory that it is not supposed to be accessed or that the program is trying to perform a function it cannot perform. This error often forces the user to exit the application and reboot the computer. GPSFs were formerly known as an unrecoverable application error (UAE) in Windows 3.0. See **reboot**.

general-purpose computer—A computer equipped to perform tasks after software is installed. Many types of computers, from mainframes to PCs, are general-purpose computers. See **mainframe**. See **personal computer**.

general-purpose language—A type of computer programming language that can be used to create a variety of programs. For example, BASIC, C, FORTRAN, and Pascal are general-purpose languages. Compare to special purpose language. See **programming**. See **language**.

generation—A computer introduced as a result of a technological breakthrough. Hardware, such as microprocessors, also can be classified in generations. For instance, Intel Corp.'s Pentium processor line makes up the generation following the company's 80486 CPU line. Programmers may also refer to generations of commands, implying a lineage of processes—one process that may give rise to other processes. When users store files in directories and subdirectories, this relation is sometimes expressed in generations—with a grandmother, mother, and daughter directory or file.

geographic information system (GIS)—A type of software that allows users to create, display, and/or manipulate mapping information. These maps can be used for business, research, geographic, and numerous other applications to graph data, such as trends or marketing information. In many applications, users can use icons to represent landmarks and other points of interest or even to pinpoint their own locations.

germanium (Ge)—An element used in the first semiconductors. Most current computers use silicon instead because of its plentitude and because of germanium's sensitivity to heat. See **semiconductor**.

gesture—A shape or figure a user draws, using a pen-like input device, to call up a command or action. Any handwritten symbol or shape, such as a dash or checkmark, that a computer can understand.

ghosting—When an object or icon dragged across the screen leaves a trace behind it.

GHz—See **gigahertz**.

GIF—See **Graphics Interchange Format**.

giga (G)—Used to represent 1 billion, or 10 to the ninth power. In computer terminology, however, the prefix giga means 2 to the 20th power, or 1,073,741,824.

gigabit (Gb)—A common measurement for 1 billion bits. One gigabit equals 1,073,741,824 (2 to the 20th power) bits, but the number is usually expressed as 1 billion.

gigabits per second (Gbps)—A measurement of data transfer equaling about one billion bits per second. Ultra-high speed networks are just now starting to implement this speed. Gigabit Ethernet networks are currently being introduced on a small scale and are most suitable as a high-bandwidth backbone and as a way to connect routers, switches, and hubs. Gigabits per second should not be confused with gigabytes per second (GBps), which is billions of bytes per second. See **bit**. See **byte**. See **data**.

glare screen

gigabyte (GB)—Approximately 1 billion bytes, or 1,000MB. One GB equals 1,073,741,824 (2 to the 30th power) bytes or 1,024MB, but these figures are typically rounded to 1 billion. Often used when measuring the capacity of hard drives or other storage devices. See **megabyte**.

gigaflop—Equal to 1 billion floating-point operations per second (FLOPS). Floating-point operations can be performed by a math coprocessor inside a computer and can help a computer quickly calculate large numbers. See **floating-point notation**. See **math coprocessor**.

gigahertz (GHz)—A common measurement of frequency, equaling 1 billion cycles per second. See **hertz**.

gigaPOP—A high-speed Point of Presence (PoP) that supports data transfer rates of at least one gigabit per second (Gbps). Few gigaPOPs exist, and most of them are not part of the regular Internet, but rather Internet2 (I2), a successor to the 'Net just now being implemented. Regular PoPs are generally used by Internet service providers (ISPs) to connect modems to the Internet and are spaced out so that the ISP's customers can call a PoP without dialing long-distance. See **Internet2**. See **Point of Presence**.

GIS—See **geographic information system**.

GKS—See **graphical kernel system**.

glare screen—A clear panel or filter, usually a fine-mesh screen, positioned in front of a computer's monitor to keep reflected light from harming a user's eyes. Glare is often the culprit behind eyestrain and headaches suffered by those who use computers for a long time. All glare filters reduce glare, but some claim to cut down on the harmful emissions given off by monitors. Also called a glare guard.

glitch—A minor problem with a program usually caused by some kind of an interruption in power to the computer, a bug in the software, or a hardware problem.

global—A global action or characteristic is always related to the entity as a whole. For example, an action that affects an entire file, directory, program, or project.

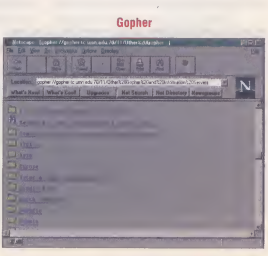
global positioning system (GPS)—A network of satellites that helps users determine their location on Earth. With the right software and a GPS modem/ receiver, anyone can establish a connection to these satellites, run by the U.S. government, to establish his or her exact location on a software-based map, usually within 50 to 100 feet. GPS systems are useful both for outdoorsmen and drivers trying to find their positions on a street map. The satellites continuously transmit radio signals as they orbit Earth. A GPS modem/receiver secures signals from three or more satellites to calculate its position. Locking onto a fourth satellite enables users to calculate altitude, which is handy for airplanes and users in mountainous areas.

global search and replace—A feature used to fix an error that has taken place throughout an entire document. See **search and replace**.

go word—A keyword used in the CompuServe online service to search for a particular subject. For instance, a user might type Go: helpfor to post questions using the Help Forum. This feature is the same as Jump when using Prodigy and Keyword when using America Online (AOL).

Gopher—A menu-driven, search-and-retrieval tool that helps Internet users locate information online through menus, which are itemized according to collections of information and stored databases. The menus also may lead to other menus, files, and search tools. Developed at the University of Minnesota in 1991 and named after the school's mascot, the Golden Gophers, Gopher lets users retrieve data over the Internet without using complicated commands and addresses.

Gopher



gopherspace—A generic term for all information and servers available through a Gopher site.

GPF—See general protection fault.

GPPM—See graphics pages per minute.

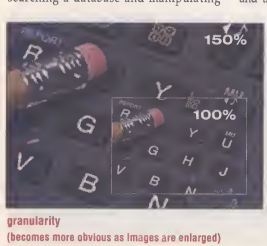
GPS—See global positioning system.

grabber—A video device that captures images from video and then changes them into a digital form the computer can understand. A grabber can refer to the hardware card that captures the video frame or the software that grabs the image and stores it as a file.

gradient fill—A graphical special effect that produces a three-dimensional color look. A gradient fill uses a gradual blend from a light background to a solid foreground or from one color to another.

grammar checker—A program, sometimes built into a word processor, that checks writing to make sure it is grammatically correct. It can check for problems, such as incomplete sentences and wordiness, but is not necessarily 100% accurate. Like most spell checking software, a grammar checking program will suggest revisions to the user before making any of the proposed changes. See **spell checker**.

granularity—A measurement or degree of an image's on-screen clarity. The smaller the dots that make up an image and the more dots used, the clearer the image. Bigger dots make the image appear grainy. Granularity also refers to the degree of difficulty in searching a database and manipulating data. If a search's features are not specific enough, a database might be considered quite granular.



granularity
(becomes more obvious as images are enlarged)

graphic—The digital version of an image, photograph, or picture displayed on a monitor screen. The computer must change photographs or other images into the digital form of files for it to understand and work with them.

graphics character

graphic character—To create letters and numbers on-screen, the computer creates them as graphics and stores them as binary codes. Any letter or number that fits the ASCII (a binary code for text) guidelines has a graphic character. See **American Standard Code for Information Interchange**. See **binary**. Compare to **graphics character**.

graphical kernel system (GKS)—An international standard for computer graphics that defines how graphics are handled by software rather than hardware. The system allows graphics to be created on one computer system and then viewed on another with few or no alterations.

graphical user interface (GUI)—(Pronounced gooey.) A GUI uses graphical symbols, called icons, and menus to carry out commands, open files, and select options. The GUI can be operated with a mouse or a keyboard. It is designed to be easier to use than a character-based interface, such as DOS, which requires exact commands to be typed at a prompt. Popular GUIs include Microsoft Windows and the Macintosh operating system (OS). See **character-based interface**.

graphics accelerator card—A circuit board that reduces the time a computer takes to produce an image on-screen. A graphics accelerator card allows a computer to work quickly because the card has its own built-in memory and processor to handle basic graphics functions, such as line drawing and pixel creation, for the microprocessor. The extra processor power frees up the computer's microprocessor to run software.

graphics adapter card—See **graphics controller card**.

graphics character—A character typed in combination with other characters to create graphics. For example, you can arrange hyphens and pipe symbols to create a box on-screen. Compare to **graphic character**.

graphics controller—A chip, also known as a graphics coprocessor, similar to a microprocessor ordinarily found on graphics accelerator cards. It processes the graphics to create dots and lines on-screen. With a graphics coprocessor handling the graphical tasks, more processing power is freed up in the computer's CPU. See **graphics accelerator card**. See **microprocessor**.

graphics controller card—A type of circuit board residing inside a computer case that controls a monitor's advanced functions. The controller card directs the computer when creating on-screen graphics and text. The type of card and monitor used determines which kind of resolution, refresh rate, and colors are possible. Common types are VGA, color/graphics adapter (CGA), and Super VGA (SVGA). Also called the display adapter, video adapter, or graphics adapter card. See **color/graphics adapter**. See **Super Video Graphics Array**. See **Video Graphics Array**.

graphics conversion program—A program that converts an image in one graphics file format to another. A graphics conversion program can be used, for instance, to convert a Graphics Interchange Format (.GIF) file into a form usable by the Windows 3.1 Paintbrush application because Paintbrush cannot display graphics in .GIF format. See **Graphics Interchange Format**.

Graphics Device Interface (GDI)—The graphics display component of Windows and Windows 95 operating systems (OSes). The GDI allows applications to display and print on output devices such as monitors and printers.

graphics file—A computer file that contains an image or picture in digital form.

Graphics files can be large, so they are often stored in compressed formats such as Graphics Interchange Format (.GIF) and Joint Photographic Experts Group (.JPG) format. See **graphics file format**.

graphics file format—A file format used to store images in digital form. File formats are usually indicated by a three-digit file extension. Popular graphics file formats include Graphics Interchange Format (.GIF), Windows bitmap (.BMP), Joint Photographic Experts Group format (.JPG), and tagged image file format (.TIF). Graphics file formats can be divided into bit-mapped graphics (also called raster graphics), which save the information about each individual pixel in the image, and object-oriented graphics (also called vector graphics), which save the mathematical information that defines the lines and curves making up the image. See **bit-mapped graphics**. See **Graphics Interchange Format**. See **Joint Photographic Experts Group**. See **object-oriented graphics**.

Graphics Interchange Format (GIF)—(Pronounced jif). A data compression format, used initially by CompuServe, that compresses and transfers graphic images into digital information so the computer can reproduce the images on-screen. GIF is commonly used for transferring graphics files on the Internet. Bit-mapped files compressed in this format are known by the three-digit .GIF extension at the end of the file name.

Graphics mode—A computer display mode where an image is produced by pixels. Each pixel is a unit that can be manipulated. See **pixel**. See **text mode**.

graphics pages per minute (gppm)—The number of pages with graphics (as opposed to text) a printer can print in a minute. Printing graphics takes longer than printing text, so this rate will be lower than a printer's pages per minute (ppm) measurement, which refers to the number of text pages a printer can output in one minute. Users who are buying a printer with plans of printing more graphics than text should check this measurement as well as the printer's ppm rate when printing text. See **pages per minute**.

graphics printer—Generally, a printer capable of printing graphics. The most popular types of printers today, inkjet and laser, can print graphics. Older daisywheel printers cannot.

graphics program—A software application that lets users draw, edit, manipulate, and paint images and/or work with pictures scanned into a computer.

graphics resolution—A quality measure of printed graphics. Resolution is expressed in dots per inch (dpi). Generally, a higher number of dpi yields a higher-quality graphic. See **dots per inch**.

graphics tablet—A rectangular, flat input device that lets users control an on-screen cursor by tracing a finger or a stylus across the surface of the tablet. Graphics tablets are used instead of a mouse or trackball when more intricate cursor control is needed, such as when using a drawing or graphics program. Also called a digitizer, digitizing tablet, or drawing tablet. See **stylus**.

graphics tablet

grayscale—A type of screen display that uses dots and shades of gray from white to black to form images. The more shades of gray an image can include, the better the quality and depth of the image.

greeking—Fake characters, symbols, and gray lines used in an application to represent on-screen text when the real text is much too small to read. Columns of text are often greeked in a word processing or desktop publishing program.

green book—A set of specifications for the CD-interactive (CD-i) standard. See **CD-interactive**.

greeking

grid—An array of reference points that make up the intersection of a parallel series of lines running perpendicular to another set of parallel lines. Basically, this rectangular array of reference points is made up of lines that crisscross at right angles. A spreadsheet is a good example of a grid.

grommet—A loop of plastic used to fasten cables together or an eyelet made of metal or plastic. Such eyelets are used to strengthen or protect an opening that wires pass through or to insulate or protect the wires.

grounding—The act of touching a metal surface to discharge static electricity. It's always wise to ground oneself before working inside a PC because the static electricity can damage electronic circuits inside the PC's case.

group 3 protocol—An international standard for facsimile protocols that defines how two systems (fax machine or computer) will send and receive faxes over regular phone lines. The group 3 protocol, as well as groups 1, 2, 3 bis, and 4 protocols, were devised by the International Telecommunications Union (ITU) in Geneva, Switzerland, to ensure fax machines from different manufacturers could communicate with each other. The group 3 protocol is a common protocol used today and allows the transmission of an 8.5-inch by 11-inch page in approximately 20 seconds.

group 4 protocol—An international standard for facsimile protocols that defines how two systems send and receive faxes (fax machine or computer) over Integrated Services Digital Network (ISDN) lines. See **Integrated Services Digital Network**.

group icon—See **program group**.

groupware—A type of software designed to let users on a network use the same software and work on projects at the same time. A popular groupware product is Lotus Notes,

which is software that, among other applications, lets users work on the same documents and exchange electronic mail (E-mail).

GUI—See graphical user interface.

gutter—The blank space that runs between the text on two pages of a document when the pages are side-by-side. A gutter also can refer to the blank space running between two columns of text in a document.

G

H

H.323 standard—A standard set by the International Telecommunications Union (ITU) to maintain real-time audio and video over packet-switched structures or networks such as the Internet. H.323 is one of the primary and most widely supported standards for Internet telephony. See packet switching.

hacker—Computer jargon for a technically sophisticated user who spends a lot of time at a computer. Originally, it referred to a person who wrote computer programs, "hacking" up the digital code. Hacker is widely used to refer to people who illegally break into computer systems to do damage, steal secrets, or enter simply because they can. Compare to cracker.

half-duplex transmission—The transmission of data in one direction at any given time. Most speakerphones are half-duplex, and telephones are full-duplex, which means both people can talk at a time. With half-duplex modems, while one modem is sending information, the other modem must wait until the first modem's transmission is complete before it can begin sending its own data. This makes half-duplex modems awkward for use in 'Net telephone conversations, not to mention time-consuming when you're paying for online time. Compare to **full-duplex transmission**. See **simplex transmission**.

half-height drive—A drive half the height of a standard diskette drive, hard drive, or cassette drive. A half-height drive measures about 1-5/8 inch in height.

halftone—In desktop publishing, a halftone image is created using dots, changes are made in brightness and tone. For example, black and white dots create different shades of gray (more black dots will create a darker area). When all these levels and layers of gray are printed, they blend and form the image. The higher the resolution of the image and printer, the smoother the image of black-and-white dots and the greater number of gray tones possible.

halftone

halo effect—Halos, or areas of light around bright objects, that appear on a computer monitor when they shouldn't. The halo effect is a sign of an inferior monitor.

halo effect

hamming code—When data travels over telephone lines, this code checks for and then corrects errors in bits. To do so, it sends "check" bits at the end of every four data bits. When the data is received, the check bits can be used to see if the four data bits were received and to correct errors. See bit.

handheld computer—A PC held in the palm of a user's hand. Handheld computers include palmtop computers and personal organizers, which run software such as calendars and contact managers. Because these computers are small, components such as keyboards must be smaller, occasionally making it necessary to use handwriting recognition to input data.

handheld scanner—See optical scanner.

handles—When users select a graphic within a graphics program, a box ordinarily appears around it. Making up this box are small squares, usually four, six, or eight, called handles. Users can drag the handle boxes to reshape or resize the image or the image box. A handle also can refer to a user name or alias on an online service or to a temporary name or number assigned to a file or other object.

handling code—Often called event-handling code or error-handling code, this is a code written to handle specific situations. For example, error-handling code is called into use when an error is detected to keep program errors from crashing the computer. The error-handling code can direct the computer or the parent program to reset a variable, reset the program, terminate the program, or reboot the computer, among other options. Likewise, event-handling code is only called into use when the event that triggers it is detected (for example, the code in a Java applet that handles the event of a user clicking a certain button).

handshake—This term is used in several areas of computing to refer to what two devices do before they begin communicating with each other. During the handshake, the two devices greet and identify each other. Then they establish which protocols will be used to transfer data. There can be handshakes between modems during online communication, or between other hardware devices, such as a printer and PC before printing. See XON/XOFF.

hands-on—Learning about a program by reading a book or online help information is passive, but hands-on information is interactive, meaning a program may offer tutorials that walk users through steps or let them ask the help system questions in their own words.

handwriting recognition—A technology that lets a computer recognize and understand handwritten text, such as a signature, sentence, or document, and change

it into data the computer can use and understand. Development of this technology has had its setbacks due to the variations in handwriting from one person to another.

hang—Occurs when a computer fails to switch applications or execute commands as quickly as it should, causing the system to lag and freeze-up. Such a situation means the machine will not recognize input from the keyboard or mouse. To recover from a hang, it is often necessary to reboot the computer. See **lag**. See **reboot**.

hanging indent—Instead of indenting the first line of text to the right, a hanging indent makes the first line in a paragraph hang farther to the left. This makes it look more like an "outdent" than an "indent." See **indent**.

Happy Mac—A small icon that appears on an Apple Macintosh computer screen when the computer recognizes a startup disk. The icon looks like a small Macintosh all-in-one computer with a smiley face. If this smiley-face icon does not appear, and the unfortunate user sees a Sad Mac icon instead, it can mean bad news. See **icon**. See **Sad Mac**.

hard card—A hard drive storage device inserted into an expansion slot inside the computer. Ordinary hard drives include the actual drive that fits into the computer and an expansion card that works as a go-between for the computer and the hard drive. A ribbon then connects the expansion card and the hard drive. But hard cards do not require any ribbons or cables because they connect directly to the motherboard through the expansion slot. While these cards may have smaller storage capacities than regular hard drives, they do work more quickly. See **expansion slot**. See **hard drive**.

hard code—Instructions for a computer or device that is physically encoded and can't be altered. Hard-coded instructions are important to a specific operation of a device or require it to work in a limited way. For instance, a program may be hard coded to work with only a certain type of printer.

hard copy—A document printed on paper or other physical media. A hard copy is the physical version, as opposed to an electronic soft copy. See **soft copy**.

hard disk—The inflexible platters inside a hard drive, the main data storage device in desktop computers. Hard disks are the actual media on which the hard drive stores information magnetically. These round disks rotate as the hard drive's read/write heads record or retrieve information from the platters; it is a little like a record player arm over a record. Hard disks are usually sealed inside the hard drive's casing to keep out dust and particles. Typically, a hard drive holds two to eight platters. See **hard drive**. See **platter**.

hard disk interleave—See **interleave**.

hard drive—A computer's main storage device, also called a hard disk drive. It consists of rigid platters fixed inside a sealed casing. A hard drive can store more information and retrieve more data than a diskette. For instance, a hard drive can hold from 2 megabytes (MB) to 9 gigabytes (GB) of data (and the amount keeps increasing), while the average diskette can hold either 1.44MB or 2.88MB (if it's a double-sided diskette). Most hard drives are permanently stored inside the PC's case, although some hard drives are portable and can be removed from the system. See **hard disk**.

hard drive controller—The go-between for the hard drive and the rest of the computer. It synchronizes read/write activities, allows the drive to communicate with the rest of the computer, and permits the computer to access the drive. On newer drives, the hard drive controller is usually located directly on the drive.

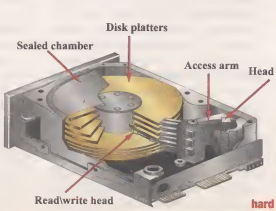
hard drive type—On older computers, a numbering system developed by hard drive manufacturers that gives the computer information about the individual components in a hard drive such as read/write heads. The hard drive type number usually can be found on a sticker on top of the drive; this number must be relayed to the computer in its BIOS. When the user installs a new hard drive, in order to ensure it works properly, the new hard drive type must be entered in the computer's BIOS. See **Basic Input/Output System**.

hard error—An error that occurs because of a hardware problem or because the computer tried to work with an incompatible hardware device.

hard fonts—An outdated term that refers to typefaces programmed onto a plug-in module for a printer, called a printer cartridge. Printers today mostly print soft fonts stored in the computer's memory or the printer's own memory.

hard return—In a document, a hard return occurs when the user hits the ENTER or RETURN key to proceed to the beginning of the next line of text—usually to indicate the end of a paragraph. A soft return occurs when users come to the end of a line of text and the computer automatically "wraps" the text and jumps to the beginning of the next line. Compare to **soft return**.

hard space—A space inserted by the Spacebar and viewed by the word processor just like a character in a document. A hard space ensures a word processor does not accidentally break up a proper name between two lines.



hardware—Any touchable part of a computer system. Printers, keyboards, monitors, mice, modems, and the computer unit itself are all hardware. Compare to **software**.

hardware-dependent—A program or programming language that will work only with a specific kind of hardware.

For instance, a device driver, which helps the operating system (OS) communicate with the peripherals, may be hardware-dependent and work only with a certain device, such as a printer or mouse. See **device driver**.

hardware interrupt—A request from a computer component for software or microprocessor attention.

hardware key—Hardware keys act as security devices. Some computer systems, and some expensive software or peripherals, require users to insert a key before the hardware will run. If there is no key, there is no operation. Some computers have a key that plugs in the front or back of the system, while some programs or peripherals will install a special key box in the port. The peripheral or software will not work if the key is not inserted in this box because the box contains a required code or password for the device.

hardware monitor—Some computers are equipped with monitoring devices that are connected to the hardware circuits to oversee how the hardware works with the system or to indicate when a problem occurs.

hardwired—A function built into a system's hardware, rather than software, to perform a task. The capability to perform a task can be built in through an extra microchip, instead of programming the task into software. For example, some computers might include Motion Picture Experts Group (MPEG) video as hardware instead of relying on software to do the job. However, the term occasionally is used when referring to software. It might also be said that a feature is hardwired into software if that feature cannot be manipulated or changed by the user.

hashing—A database indexing method that assigns information specific numeric values or indexing keys to better locate data. Hash indexes are more compact and faster for exact searches, but they cannot do approximate searches (such as finding all words that start with "bene-"). B-Tree (or balanced-tree) indexes, the kind of indexing offered by databases such as FileMaker Pro by Claris Corp., support approximate and exact searches. They also provide the index values in a sorted order, another thing a hash index cannot do. Most higher-end

hat switch

products offer a single database with both kinds of indexes.

hat switches—A small, thumb-controlled button on a joystick that allows users to change a viewpoint in a game, be it which direction to look (i.e., left/right or forward/back) or to control another sensory device, such as radar.

HDLC—See **high-level data link control**.

HDTV—See **high-definition television**.

head—The read/write head inside a disk drive that uses magnetic-electric currents to store and access digital information on platters. The movements of the read/write heads are controlled by a mechanism called the head actuator. See **actuator**.

head actuator—See **actuator**.

head arm—See **access arm**.

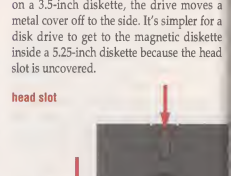
head cleaning—Cleaning read/write head devices on a diskette drive. The process removes dust and debris with a cleaning material.

head crash—This serious error occurs when the hard drive is physically jarred. This can happen if dust or other matter comes in contact with the disk or read/write heads; if the computer is bumped while the read/write heads are recording information to, or accessing information from, the disk; or if the computer is accidentally shut down while the read/write heads are in action. The read/write heads in a hard drive work by gliding just above the platters inside, and, in a head crash, sometimes the head actually touches the surface of a spinning platter. This can destroy the drive because the platter can be severely scratched and may cause data to be lost. See **hard drive**. See **head**.

head electronics—The circuits that power the actions of read/write heads, the head actuator, and the access arm.

head positioning—Occurs when read/write heads are moved into position inside a hard drive, above portions of the disk platters, to record or retrieve information. See **hard disk**. See **hard drive**.

head slot—The slot or opening at the top of a diskette, 5.25-inch and 3.5-inch, that provides access to the magnetic diskette inside. The read/write head in a disk drive must directly access the magnetic diskette to store and retrieve information. To get to the magnetic diskette through the head slot on a 3.5-inch diskette, the drive moves a metal cover off to the side. It's simpler for a disk drive to get to the magnetic diskette inside a 5.25-inch diskette because the head slot is uncovered.



head switching—When a hard drive switches from recording and retrieving with one read/write head to performing the same actions with another. See **head**.

header—A section of an electronic message, ordinarily at the beginning of the message, that routes it to its destination and often identifies the sender. Another type of header is text such as numbers or chapter titles that appear at the top of each page in a document. In data storage, a header lists a file's name, size, and the time and date of its creation or revision. In a database, a header is a record identifying the fields and kinds of information in the following data records.

heap—A term used by programmers for the "heap" of memory a program needs available for it to work. Heap memory has been set aside for a program to request as needed to operate. A set amount of heap memory is hard to determine before a program is started because the amount changes as a program runs.

heat sink—Some computer components generate heat as they operate because they run so quickly. To prevent components from overheating and breaking down, heat sinks may be installed to absorb and eliminate the heat. Often, computer manufacturers install these small metal devices on powerful microprocessors, such as Pentiums and Pentium Pros, to keep them from overheating.

help—A menu item in most programs that provides electronic assistance. Textbook-like help is available for searching and may be context-sensitive, meaning the help may change according to the type of function or program users are working on when they select the help option. Although most help files are usually portions of the manual put on-screen, some help options also may include tutorials and tips on how to use the program.

Hercules—A standard for graphics cards that indicated how to display images on a monitor. Hercules was one of the early standards introduced in the early 1980s, developed by Hercules Computer Technology for IBM computers. The standard called for a resolution of 720 pixels by 348 pixels on a monochrome monitor. The standard came and went with the advent of color monitor standards.

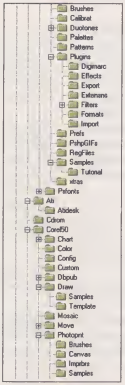
hertz (Hz)—Equals one cycle per second, measuring the waves or frequencies of electric vibrations. Hertz is used to measure screen refresh rates and the speed of microprocessors.

heterogeneous network—A network made up of different types of computers, possibly including both IBM-compatible computers and Macintosh systems.

heuristic—A method for solving problems that relies on trial and error, as opposed to algorithmic problem solving, which relies on static formulas and equations. Heuristic programs can learn; they develop common sense rules for solving similar problems and then use them to solve the same type of problems in the future. Many software technologies use heuristic programming. Antivirus programs can use algorithms to check for viruses, but if the virus doesn't match a known bug, the program won't detect it. Heuristic scanning, on the other hand, looks for suspicious code, code that the heuristic scanner had come to "know" resembles viral activity such as deleting or damaging files. Heuristic scanning methods are used primarily by those who are on the hunt for new viruses. They can set off too many alarms to be of use to regular users.

Hewlett-Packard Graphics Language (HPGL)—A Hewlett-Packard Vector series graphics language used by HP plotter printing devices. The file format is currently supported by most IBM-compatible plotter devices for printing and storing graphics files.

hexadecimal numbering system—A base-16 numbering system using combinations of 16 digits to represent all numerical values. In addition to the 10 digits used in the familiar decimal system (0 to 9), hexadecimal uses the letters A through F. For example, the number 10 would be A in hexadecimal. The decimal number 17 would be written as 11 in hexadecimal. Computers often use hexadecimal numbers to describe memory addresses. Hexadecimal numbers are sometimes followed by the letter H to avoid confusion with decimal numbers.



hierarchical file system

hidden files—Files that do not appear when users view a list of files using the DOS DIR, COPY, and DELETE commands. Usually, they are system files that could cause the operating system to malfunction if they are changed or removed. The hidden attribute can be turned off and on; in DOS, users can do this with the ATTRIB command. File management tools, such as Windows Explorer in Windows 95 and Windows 98, let users easily choose whether they see hidden files. This option is available under Windows Explorer's View menu and the Options selection. Clicking the button labeled Show All Files will reveal even hidden files in directory listings.

hierarchical file system—A tree-like system of folders and directories. At the roots of the tree is the main directory, usually called the root directory. The root directory may branch off into other subdirectories or files. Each of these subdirectories may have subdirectories of their own and/or contain related files.

hierarchy—A way of organizing information or objects in which related objects branch from one another in a tree-like shape. At the bottom are the main, or most important files or data, branching out to hold other directories, files, or data. Computers use such systems to organize items that are related on storage media such as hard drives.

high-definition television (HDTV)—A new television system that generates crisper, cleaner, and clearer images than conventional television pictures and will likely bring hundreds more channels into homes. In the United States, HDTV will also incorporate digital broadcasting signals. Because current industry standards use analog signals, HDTV will require new digital transmitting and receiving equipment and television sets to produce images. HDTV is still in the testing stages; however, the system should be ready for the mainstream consumer market in the next couple of years. See analog. See digital.

high-density diskette—A 3.5-inch diskette capable of containing up to 1.44 megabytes (MB) of data or a 5.25-inch diskette capable of containing up to 1.2MB of data. High-density diskettes are generally marked with the initials HD. Packages of lower density diskettes are usually labeled

2S/DD for "two-sided, double-density."

high-level data link control (HDLC)—A communications protocol that organizes messages in frames and places certain communications control factors in the same position every time.

high-density diskette

high-level data link control (HDLC)—A bit-oriented, synchronous communications protocol that was developed by the International Organization for Standardization (ISO). HDLC organizes messages into units, which are called frames. Each frame may contain different amounts of data, but under HDLC protocol, certain communications control factors must be in the same position for every single frame. See **International Organization for Standardization.**

high-level format—A type of formatting that initializes a portion of a hard disk and creates important DOS system areas on the disk. A high-level format is usually done by the end user and does not create physical tracks on the surface of the internal disks like a low level format. The FORMAT command ordinarily performs only a high-level format to drives and diskettes. Compare to **low-level format.** See **FORMAT.**

high-level language—A more advanced computer programming language that is not limited to being used on one type of computer or for one specific type of job. The programming language is flexible and used to program a variety of everyday computer tasks; it uses commands and works in a way closer to what humans can understand, as opposed to straight computer code. A high-level language is a little more abstract than ordinary languages, but less abstract than languages used by machines. High-level languages let humans tell the computer what they want it to do in a manner the computer can understand. Such languages include BASIC, C, FORTRAN, and Pascal. See **programming language.**

high memory—See **high-memory area.**

high-memory area (HMA)—High memory refers to the first 64 kilobytes (KB) of extended memory, anything above the first megabytes (MB) of memory. Users can swap programs out of conventional memory into the high memory area and trick the computer into thinking there is more conventional memory, increasing the amount of memory available for programs. See **conventional memory.** See **expanded memory.** See **extended memory.** See **upper memory area.**

high-performance file system (HPFS)—The resident file system for OS/2 versions 1.2 and later, used to organize and retrieve files from various storage devices. HPFS supports long file names and large hard drives. For OS/2 users, the HPFS is an alternative to DOS' File Allocation Table (FAT) system, although OS/2 can run either the HPFS or FAT system. See **file allocation table.** See **file system.** See **OS/2.**

High Performance Parallel Interface (HIPPI)—A method developed at the Los Alamos National Laboratory for connecting computers at high speeds. The method is generally used only to cross short distances and relies on 50 copper, twisted-pair wires which provide 32-bit throughput and maximum transmission speeds of 800 megabits per second (Mbps). Using dual cables allows rates of 1,600Mbps. HIPPI also provides improved switching. HIPPI connections are generally used to connect supercomputers or as part of a backbone connection that connects one local-area network (LAN) to another. A new HIPPI standard, HIPPI-6400, promises speeds of 6.4 gigabits per second (Gbps) with a maximum range of 25 meters. Using fiber optic cable instead of copper, HIPPI's range can be extended to at least one kilometer, and in some cases, 10 kilometers.

high-persistence phosphor—A kind of neon phosphor that glows longer after it is illuminated by monitor electrons. It can be found in some cathode-ray tube (CRT) monitors, but most systems do not use it because it is not desirable to have the on-screen image linger after another is brought up. See **cathode-ray tube.**

high resolution—A term that refers to monitors or printers that produce high-quality output because they generate more dots per inch (dpi). One monitor or printer may be able to create more pixels or dots than another, giving it a better image quality and higher resolution. For example, if a printer is described as having high resolution, it's probably a laser or inkjet printer or an advanced typesetting machine that may be able to produce anywhere from 600dpi to more than 1,200dpi. See **resolution.**

High Sierra—This is a specification for CD-ROMs, named after the location of a meeting near Lake Tahoe in 1985 in which the specification was defined. This specification determines such standards as the structures of the files and the method by which they are recorded on a CD. Later, High Sierra gave way to a CD-ROM format called the ISO 9660.

High-Speed Digital Subscriber Line (HDSL2)—A symmetric form of a digital subscriber line, meaning speeds are equal in both the upstream and downstream directions. An HDSL line can provide bandwidth of up to 1.544 Megabits per second (Mbps; 2.408 Mbps in Europe) over a regular phone line. Unlike asymmetric DSL lines, it cannot share a telephone line with a voice line; it is a data line only. HDSL is an efficient way to provide T1 service because it can run on regular phone cable instead of the fiber optic cable traditionally used to provide T1 service. It will only work within 12,000 feet of a telephone switching center, however. See **digital subscriber line.** See **T1.**

high-tech—A term that refers to something new and on the cutting edge of technology in electronics and computers.

highlight—Any indication that a text block or an object has been selected with a mouse-click or the arrow keys on the keyboard. The highlight may appear as a change in the color of text or as a border around an object. A highlighted object is usually ready for some type of operation, such as deleting highlighted text in a word processor.

HIPPI—See High Performance Parallel Interface.

histogram—A chart made up of horizontal and/or vertical bars indicating values. Their length is directly related to the value of the data the bars represent. For instance, a graphics program may use histograms to show the quantity of items sold; the longer the bars, the more items were sold.

hit—Each individual request made in a World Wide Web (WWW) server's log. The number of hits a Web page receives equals the number of times a part of that page has been accessed. One Web page could receive as many hits as it has files to download. Typically a page will include a Hypertext Markup Language (HTML) text file and several other files including graphics, sound, video, and/or text. Thus a page made up of one HTML file and nine graphics files that receives 1,000 hits has been viewed 100 times. This information can be useful, but many advertisers are more interested in page impressions, which count the actual number of visits to a page.

hologram—A three-dimensional image that lets viewers see different sides and different dimensions of the image. Holograms are created by recording how light hits an object, using light-sensitive crystals. Eventually, text and images may be stored as holograms rather than on conventional storage media because more data can fit in less space when stored as a hologram.

home—In a text-based environment such as DOS, home refers to the uppermost left corner of a screen. In word processors, home can mean the beginning of a document, page, or current screen. See HOME key.

home computer—A computer built and marketed by the manufacturer for use in the home by the average consumer. Most home computers include personal productivity, entertainment, and educational software. These systems are generally cheaper than a high-end, corporate computer and, thus, more affordable for a home user. New technology quickly appears on home computers because applications such as games require powerful components.

HOME key—A key located on most keyboards that will move the cursor to the beginning of a line of text in most word processing programs. Oftentimes pressing this key at the same time as the CTRL key will move the cursor to the upper-left corner of a document.

home page—The name for the main page in a Web site where users can find hyperlinks to other pages in the site. It is like a welcome mat for a site on the Internet and may include a logo, table of contents, and/or hyperlinks to related sites. Compare to Web page. See Web site.

hookemware—Software that can be purchased or downloaded and used for a short trial period, after which the software expires. The point is for consumers to be hooked on the software and feel the need to run out and buy it. Compare to freeware. Compare to shareware. See proprietary software.

horizontal portal—A portal Web site, such as Yahoo! that does not have a specific topic and is designed for a broad audience. See vertical portal.

horizontal redundancy—See longitudinal redundancy check.

horizontal scan rate—The speed at which one line is drawn across the width of a monitor's screen, usually expressed in kilohertz (KHz). If there is a high horizontal scan rate, a computer's resolution will be better, and images won't flicker on-screen.

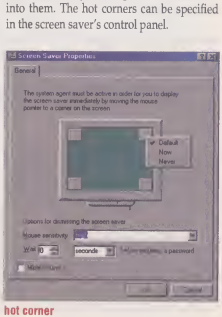
horizontal scrolling—The ability to move a document or spreadsheet beyond the limits of a screen to the left or right. Scrolling is usually performed by clicking an arrow on the top or bottom of a window.

host—A computer that shares information with other computers, or the act of sharing information with or providing services for other computers. Examples of host computers include: a file server, which shares files and programs with other computers on the network; a Web server, which shares content with the rest of the Internet; and a mail server, which accepts E-mail messages and sends them to the intended recipients.

host computer—A network computer to which other computers in the network are connected. A host computer can be set up to do the bulk of the computing on the network and store files and databases.

host language—See native language.

hot corner—The corners of the screen that control a screen saver. One hot corner will activate the screen saver. Some screen savers also specify another corner that prevents the screen saver from activating. The hot corners are activated by moving the mouse cursor into them. The hot corners can be specified in the screen saver's control panel.



hot corner

hot shoe—On cameras (including digital cameras), the u-shaped mount atop the camera that external flash units are inserted into. It's used to trigger not only camera-mounted flashes but also professional studio lighting.

hot spot—On-screen locations linked to a command or action. For instance, an icon or highlighted word might be linked to a video or to another program. When users click the video icon, a video plays. Hot spots may be used for all types of tasks, including opening a file, viewing a picture, playing a sound clip, or jumping to another page. Some hot spots even let users perform actions. An example of this is changing the size of a window on-screen. To do this, move the cursor until it turns into the shape of a double arrow, then drag the border until the window reaches the desired size.

hot swap—To replace a computer component while the computer is powered on. This ability is especially important for mainframe computers or servers in a client-server system that can't afford downtime. These computers generally have redundant parts such as hard drives and power supplies to ensure reliability, and these parts can be switched out if they fail. Storage systems on client-server networks also often use hot swap functions for the same reasons. For personal computers, the advent of the Universal Serial Bus (USB) standard lets users hot swap peripherals into the USB port and have the computer automatically recognize them without rebooting.

hotkey—A key or combination of keys, such as CTRL and an alphanumeric character, that activate a pop-up program or cause some other predetermined action to occur. For instance, SHIFT and F7 are hotkeys used to print in DOS versions of WordPerfect.

hotlink—A connection between programs that lets the user change information in one program while the computer changes the same information in the programs linked to it. Compare to **hyperlink**. See **object linking and embedding**.

hotlist—A compilation of the most recently or most frequently visited documents and files. For example, a World Wide Web hotlist contains a list of the sites last visited by a user. In Netscape Navigator, the hotlist is also known as "bookmarks," while Microsoft Internet Explorer's hotlist alias is the "Favorites folder." See **bookmarks**.

housekeeping—Besides getting rid of the dust and debris that have accumulated on the surface of a computer and its peripherals, housekeeping also can mean optimizing the hard drive, getting rid of old or unused files, or making sure the system clock is running on time.

HPFS—See **high-performance file system**.

HPGL—See **Hewlett-Packard Graphics Language**.

HSB—An acronym for hue, saturation, and brightness. The term is used in computer graphics to accurately describe a color.

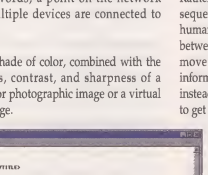
HTML—See **Hypertext Markup Language**.

HTML editor—See **Hypertext Markup Language editor**.

HTTP—See **Hypertext Transfer Protocol**.

hub—A device that connects two or more network devices so they can communicate. In other words, a point on the network where multiple devices are connected to each other.

hue—A shade of color, combined with the brightness, contrast, and sharpness of a graphical or photographic image or a virtual reality image.



Hypertext Markup Language (HTML)

Huffman code—One of the earliest methods of data compression, the Huffman code is based on how often elements appear. In this method of compression, elements used more often have a shorter code in bits; elements used less often have a longer code. See **data compression**.

hybrid computer—A computer that can work with both digital and analog signals. Usually hybrid computers convert analog signals to digital signals so the information can be processed. These expensive, specialized computers are used in engineering and robotics to control processes. See **analog**. See **digital**.

hyperlink—An icon, graphic, or word in a file that, when clicked with the mouse, automatically opens another file for viewing. World Wide Web (WWW) pages often include hyperlinks that display other Web pages when selected by the user. Usually these hyperlinked pages are related in some way to the first page. Hyperlinks include the address or file names of the files to which they point, but typically this code is hidden from the user. Hyperlinked files together form hypermedia. See **hypermedia**. See **hypertext**.

hypermedia—The joining of video, sound, graphics, animation, and other elements to form a non-sequential association of topics. Rather than forcing movement in a linear or sequential format, hypermedia allows the human thought process to make associations between topics. In other words, the user can move from one subject to another to find information on related topics as they choose, instead of paging through an alphabetic list to get to the information. See **hypertext**.

hypertext—Hyperlinked text in a file that, when highlighted by the mouse or otherwise selected, causes the automatic display of a related file. World Wide Web (WWW) pages are filled with hypertext and other hyperlinks. Hypertext is usually denoted by having a different color from the surrounding plain text. See **hyperlink**.

Hypertext Markup Language (HTML)—A language used to create electronic documents, especially

pages on the World Wide Web (WWW), that contain connections called hyperlinks. HTML tells a Web browser how to display the Web pages it receives. A standard group of tags (see chart below) tell the browser how to handle items such as text and graphics. The tag, for example, tells a browser to display text as a headline of a certain size. The hyperlinks in these files let users jump from one document to a related document by clicking an icon or a hypertext phrase. For instance, users might jump from a company name on a Web page to that company's home Web page. See **hyperlink**. See **hypertext**.

Hypertext Markup Language editor (HTML editor)—A Web-building tool that serves as a text editor for writing HTML code, a spelling and syntax checker, and a matching device that matches colors to codes for easier tracking and altering. See **editor**. See **Hypertext Markup Language**.

Common HTML Tags

Tag	Container (C) / Empty (E) *	Description
<A>	C	An anchor, or link to another web site or file.
<BODY>	C	Specifies the part of an HTML file that appears onscreen and attributes for the page, such as a background image, and background and text colors.
<B>	C	Bolds text.
 	E	Starts a new line.
<CENTER>	C	Centers text, tables, and images.
<FONT>	C	Sets the type face, size, and color of text.
<FORM>	C	Contains a form users can fill in and return.
<FRAME>	E	Specifies the attributes of a specific frame and the location of the HTML file to be displayed in the frame.
<FRAMESET>	C	Lays out the page into two or more frames. Sets the size and orientation of the various frames.
<HEAD>	C	Contains descriptive information, like the title and author, not displayed onscreen. It also holds formatting information, such as style sheets.
<H*n*>	C	Indicates text should be displayed as a header (or headline), where *n* is a number 1-6. <H1> is the largest header, <H6> is the smallest.
<HR>	E	Inserts a horizontal line.
<HTML>	C	Marks the beginning and end of an HTML-coded file.
<I>	C	Italicizes text.
<IMG>	E	Specifies the location of a graphics file to be displayed onscreen or the location of a sound file to be played.
<LI>	E	Begins a new line in a list. See **OL**, **UL**.
<OL>	C	Displays text in a numbered list.
<P>	E	Starts a new paragraph.
<SCRIPT>	C	Identifies a script and its attributes, usually used with a Java script.
<TABLE>	C	Lays text and images into a table complete with rows and columns.
<TITLE>	C	Sets the web page's title, displayed in the blue bar atop the screen.
<TD>	C	Marks the beginning and end of a cell in a table.
<TR>	E	Marks the end of a row in a table.
<U>	C	Underlines text.
<UL>	C	Displays text in an un-numbered list that uses bullets for each list item.

* Container tags have an open and close tag. To bold text, for example, you would insert a <B> before the text to bold. To return to plain text, use the </B> tag to stop bolding.

Hypertext Transfer Protocol (HTTP)—The set of standards that let users of the Web exchange information found in Web pages. You can use a Web browser, such as Microsoft Internet Explorer or Netscape Navigator, to read documents formatted and delivered according to HTTP. The beginning of every Web address, "http://", tells the browser the address' document is HTTP-compatible.

hyphen—A punctuation character used to split words or connect adjectives. In most word processors, the program automatically splits a word with a hyphen when the word extends beyond the right margin. Some word processors have a dictionary that tells them where to put the hyphens, while some use a hyphenation formula to set hyphens. Even though a word processor uses a hyphenation feature, it will still allow users to place their own hyphens or get rid of them.

Hz—See **hertz**.

I

I2C—See **Inter-IC**.

I2L—See **integrated injection logic**.

IAC—See **inter-application communications**.

I-beam pointer—The I-shape the on-screen pointer assumes where a user may insert text in a document or at a prompt.

IBG—See **interblock gap**.

IBM-compatible—A term that generally refers to the wide array of computer companies producing systems that adhere to standards set by IBM. This term was somewhat more significant in the early days of computer diversity when it specifically referred to IBM clone systems.

IBM DOS—Otherwise known as PC DOS. A text-based operating system that is nearly identical to Microsoft's DOS (MS-DOS) but sold by IBM. IBM DOS and MS-DOS had similar features until Microsoft introduced MS-DOS version 6.0. See **Disk Operating System**.

IC—See **integrated circuit**.

ICCP—See **Institute for Certification of Computer Professionals**.

icon—A small graphical image used to represent a function, object, or program. The Windows and OS/2 operating systems use icons to make file navigation and manipulation easier for users. Rather than typing in the

name of a program to execute the program, as in DOS, a Windows user simply can double-click the program's icon. Icons can also represent folders, which can contain files.

iconic interface—A connection between hardware and software components, an interface, that is composed of graphical images representing the program or function to which they are connected. See **graphical user interface**.

iconized—A program, shortcut, or Web page link represented by an icon. On some Web pages, icons represent hyperlinks. An example is linking to the White House's Web page by using a picture of the White House instead of text that says "Go to the White House." See **link**. See **maximize**. See **minimize**.

ICQ—Pronounced as "I Seek You." An online, instant messenger chat service from Mirabilis. Users can customize ICQ to alert them when friends or specified users are online so they can send or receive real-time messages from those users. See **chat**. See **real-time**.

IDE—See **Integrated Drive Electronics**.

identifier—A name, label, or title given to a function or variable.

idle time—The period of time a system or device is running or being supplied with power, but is not being used. The time during which a user is away from the computer with the screen saver running is an example of idle time.

IEEE—See **Institute of Electrical and Electronic Engineers**.

IEEE 802 standards—The standards set by the Institute of Electrical and Electronic Engineers (IEEE) for networking, specifically through local-area networks (LANs). See **local-area network**. See **Institute of Electrical and Electronic Engineers**.

IEEE 1394—A specification for a new, high-speed external bus used to connect computer peripherals. The cost to use this bus is prohibitive for all but those peripherals that demand high external bus speeds for bandwidth-consuming multimedia, such as digital cameras, digital VCRs, and Digital Video Disc (DVD) players. For other external bus devices, such as mice and keyboards, the Universal Serial Bus (USB) is more economical even though it operates at a lower speed. IEEE 1394, developed at Apple Computers and dubbed FireWire, boasts transfer speeds of up to 400 megabits per second (Mbps) and can handle up to 63 devices. Other benefits include Plug and Play, hot-swapping, and support for a constant transmission speed, which is appropriate for streaming audio and video content because it doesn't handle changes in speed well. Though developed at Apple, the technology works on Macintosh and Windows computers. See **bandwidth**.

IF statement—A programming command statement structured as an "If X, then Y" command. If the X factor proves true, then the computer executes the Y command. This type of command can be set up for a variety of functions, such as sorting numbers. For example, if you enter the statement, If x<50, then print "X is less than 50.", then the computer will, as it reads the data coming through, print this statement for all numbers less than 50.

IFIP—See **International Federation for Information Processing**.

IGES—See **Initial Graphics Exchange Specification**.

ILL—See integrated injection logic.

illegal command—A command a computer can't execute. If a computer attempts to execute an illegal command, then a warning will appear. See **command**.

illuminance—A measurement of light, such as watts per square meter. Illuminance can refer to the amount of light brightening a work space or the amount of light a monitor emits. See **luminance**.

image—A picture or graphic. Loosely refers to the text and graphics that appear on-screen. See **system image**.

image editor—A graphics program used to edit or manipulate an image, either by adding a user's special touches to a computerized drawing or by using computer-generated manipulations such as morphing. Image editors are different from drawing packages because they are specifically for changing existing images, not for generating them from scratch. See **morphing**.

image enhancement—The process of fine-tuning a graphical image; sometimes linked to image editing. The difference is that image enhancement merely fine-tunes the whole picture while image editing tends to make broader changes. Image enhancement uses software to make an image clearer and more visually specific. Examples of image enhancement include making a picture lighter or darker, manipulating contrasts, adding or "lifting" colors, and filtering irregularities to make the edges of an image cleaner. See **image editor**.

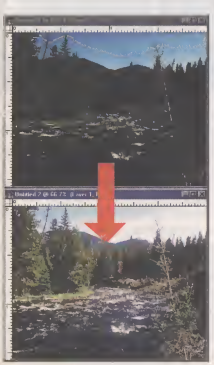


image enhancement

image processing—The use of a computer to digitally alter pictures, photos, and video. Image processing includes all three parts of the alteration: inputting an image to be manipulated via scanner or another input device; manipulating the image by editing or enhancement; and outputting the finished product and/or storing the image as a computer file.

imagesetter—A typesetting device used in desktop publishing that transfers graphics and text to a page. An imagesetter produces a higher resolution product than a printer. Also called a typesetter.

ImageWriter—A Macintosh family of dot matrix printers. See **dot matrix printer**.

imaging—The process of digitizing an image from a hard copy, manipulating the computerized picture, and recording visual images on a medium, such as a hard drive or CD-ROM.

IMAP—See **Internet Message Access Protocol**.

immediate access—A computer's ability to go directly to a requested file or piece of data instead of sifting through a list in a linear fashion. Instead of looking file by file, a computer goes directly to an assigned address to locate a file. Diskettes, hard drives, and CD-ROMs allow for immediate access, unlike tape drives. See **direct access**.

impact printer—A type of printer that leaves a mark through physical contact with the page. The print is created by a head or pin striking against an ink ribbon which then strikes the page. Daisywheel and dot matrix are examples of impact printers; laser and inkjet printers are nonimpact. See **daisywheel**. See **dot matrix printer**. See **nonimpact printer**.

import—To bring a file created in one application or system into another application or system. Some applications are designed to use files created in a variety of formats, but others can only read certain formats. One method of importing incompatible files is to convert a file from the format of the primary document to that of the secondary document using a conversion program.

inactive window—A window not being used. Operating systems that allow users to have more than one application open and more than one window to be visible at one time have active and inactive windows on-screen. Any window, other than the one being worked in, is considered an inactive window. Operating systems often distinguish inactive windows from the active window by the color of the title bars in each window. For example, if the active window has a blue title bar, the inactive window might have a gray title bar. See **window**.

in-betweening—The phase in the morphing process when one image is transforming itself into another. Also known as tweening. See **morphing**.

Inbox—The place where new and unopened mail is stored in electronic mail (E-mail) programs. See **electronic mail**.

increment—As a verb, to increase a value repetitively by a consistent amount. An example is counting to 30 in increments of five. As a noun, it refers to the amount by which an increase or decrease is made. An example of this is a step along a number line.

incremental backup—Backing up only those files that have changed since the last backup. Instead of routinely backing up all files on a system, a computer can select those that have changed and make a copy only of those. See **back up**.

indent—As a verb, to move the beginning of a line of text inward from the margin. As a noun, the space created by such a move between the margin and the beginning of text. A typical indent is five spaces. In many programs, users can press the TAB key to create an indent.

Indeo—A collection of video compression/decompression techniques developed by Intel Corp. Intel licenses Indeo to software developers and hardware manufacturers for use in their software and video

components. You can find Indeo technology in Microsoft's Video for Windows and Apple's QuickTime for Windows. When used in combination with certain hardware components and software, Indeo enables a computer to capture video images from a VCR, to digitize the captured video images, and to compress them into a computer file. See data compression. See decompression.

Independent software vendor (ISV)— An individual or company that produces only software.

Index—A way of sorting access to ideas, files, and so forth by creating an alphabetical list of keywords. An index speeds up data retrieval.

Indexed search—A search for data that is assisted by an index. See index.

Indexed sequential access method (ISAM)—Files a computer stores in the order it receives them and also in a separate list indexed by an index key, or key field, such as last name. The indexed list helps the computer access database information more quickly than a search through all the files listed in chronological order.

Index mark—A notch, hole, or magnetic strip used to mark the starting point for each track on a hard disk. The index mark is part of the computer's filing system and gives the computer a point of reference to look for specific information. Also called address mark. See hard disk.

Index track—A guide for the read/write head through the sectors of the hard disk to locate data. See head.

Indicator—The light that shows the operational status of a device. When a CPU is busy, for example, the indicator light flashes rapidly.

Indirect address—An address that works as a reference point. An indirect address points to another pointer instead of directly to information. For example, "the second house from the corner" is an indirect address, while "555 Main St." is a direct address. Also called a relative address. Compare to direct address.

Industry Standard Architecture (ISA)—The standard bus modeled after IBM's original 8-bit PC bus. In 1984, ISA was expanded to a 16-bit capability. The ISA standard allows users to add 16-bit expansion cards to special slots built into the motherboard. Though the ISA bus is outdated today, most computers still include a few ISA expansion slots to accommodate the large number of ISA-compatible expansion boards in existence. See bus. See expansion slot. See motherboard.

Inference engine—A program that gathers information from a particular database, applies known facts and laws on a particular subject, and then draws a logical conclusion. The inference engine is a type of artificial intelligence (AI) that processes information and returns a list of possibilities. For example, an inference engine could combine with other software and hardware to regulate the temperature of a swimming pool. After a digital thermometer measures the temperature of the water, it sends the data to a computer where the inference engine analyzes the data. The inference engine helps determine how to regulate the water of the swimming pool. See artificial intelligence.

Infinite loop—See endless loop.

Information processing—Collecting, manipulating, storing, and outputting information. Usually refers to processing completed by electronic means.

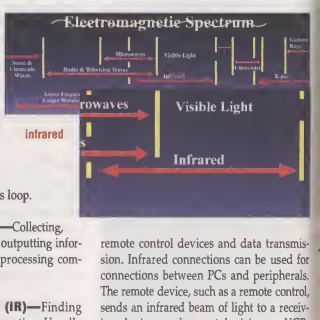
Information retrieval (IR)—Finding and displaying stored information. Usually refers to retrieval by computerized means.

Information superhighway—A term coined by Vice President Gore to describe a future, computer-accessible, high-speed, electronic communications network. The information superhighway is more of an idea for what is possible than a current reality, but the term is frequently, if not quite correctly, used as a synonym for today's Internet. See Internet.

Information systems (IS)—Often used as the name of the company's computer support department. Other common names for a corporate computer support department include information technology (IT) and management information services (MIS).

Information technology (IT)—A general term used to describe any technology that helps to produce, manipulate, store, communicate, or disseminate information. The telephone is a common device that falls in the realm of information technology, but IT can also refer to the most expensive, complex computers. IT devices usually deal with electronic data in some type of binary format. There are so many different ways of storing data electronically, however, that many IT machines are not able to communicate with one another.

Infrared—A band of electromagnetic waves slightly below the frequency of visible light. Infrared beams often are used for



remote control devices and data transmission. Infrared connections can be used for connections between PCs and peripherals. The remote device, such as a remote control, sends an infrared beam of light to a receiving device, such as a television or VCR. Because infrared devices use light beams, any obstruction in the path between the remote and receiving device will result in signal distortion or signal loss.

Infrared Data Association (IrDA)—A group of hardware manufacturers working to form a standard for infrared data transmission. Devices that conform to IrDA standards can work with one another to transfer data using infrared technology.

inherent error—An error in logic, design, or embedded information that dooms a program to failure.

.INI file—An initialization file, which is used by an application to store configuration data that it reads when it starts.

INIT—A Macintosh term that denotes system files that automatically run when the system boots. Macintosh used INIT for system extensions before System 7. See System 7.

initial cache size—With the DOS disk-caching program SmartDrive (Smartdrv.exe), the initial cache size sets the maximum size of the disk cache the computer should start with or use when Windows is not running. Generically, the term can refer to any variety of caches, from the size of a memory or disk cache to the size of a Web browser's cache. The initial cache size value is important because it's important to set aside enough of a cache, but not so much as to waste memory or disk space. See cache. See windows cache size.

Initial Graphics Exchange Specification (IGES)—A graphics file standard developed by the American National Standards Institute (ANSI) for the Air Force Integrated Computer Automated Manufacturing program. IGES is for complicated computer-aided design (CAD) programs and lets users outline and label specific parts of a drawing. See American National Standards Institute. See computer-aided design.

initial program load (IPL)—The process of loading the operating system in preparation for daily use. The operating system files are automatically brought from the hard drive to RAM when a user turns on a system. See boot.

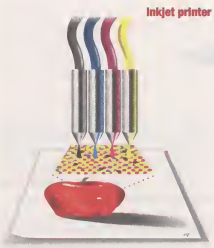
initialization—The sequence a computer system runs when started. Initialization includes self-diagnostics (the process of checking for hardware components and making sure everything is running properly), loading the operating system, and other procedures that prepare the system for user interaction.

initialize—Starting up a computer system or program or making preparations for startup.

initiator—The portion of a Small Computer System Interface (SCSI) that issues commands. See Small Computer System Interface.

ink cartridge—A disposable container that holds ink for an inkjet printer. Users can refill some ink cartridges when the ink runs dry, but many of them must be replaced. See inkjet printer.

inkjet printer—A printer that forms letters on the page by spraying tiny streams of quick-drying ink. The ink is stored in disposable ink cartridges. Inkjet printers are known to have some problems, including occasionally bleeding inks and slow



printing speeds. They do, however, have many good points. In terms of print quality, inkjet printers come close to matching the quality of print produced by laser printers. In terms of price, inkjet printers come closer to the dot matrix printer. For the latter reasons, inkjet printers are quite popular among home computer users. Compare to dot matrix printer. Compare to laser printer.

inline graphics—Any photos, illustrations, or graphics included on Web pages. Also known as inline images.

input—The information or data entered into a computer. Also can apply to commands and information or data to be processed. In some references, input is used to describe the act of getting the information into a computer.

input area—See input buffer.

input block—See input buffer.

input buffer—A portion of memory that holds incoming information before it continues to the CPU for processing.

input channel—See input/output channel.

input device—Any device that sends information into the CPU. Keyboards, mice, trackballs, and scanners are input devices.

input driver—A short program or portion of a program that directs communication between a peripheral device and the CPU. See device driver.

input/output address (I/O address)—An address used to direct traffic to and from devices attached to a computer's serial (COM) and parallel (LPT) ports or expansion cards in internal expansion slots. Each port and slot has a corresponding I/O address. COM1, for example, generally uses I/O address 3F8, although users can change its address. Some expansion cards come with an I/O address preset on the card. If the card is not set up to take advantage of those preset resources, then conflicts will occur. COM port settings are not as absolute as I/O addresses, however, so users can change COM ports to match any I/O address. See communications port. See line printer terminal.

input/output bus—The hardware pathway information travels from input/output devices to the CPU.

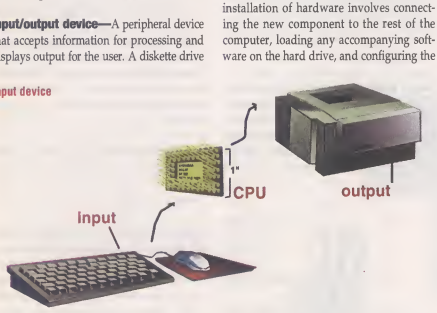
input/output card—See expansion card.

Input/output channel—A line of communication between the input/output bus and the CPU.

Input/output controller (I/O controller)—(pronounced I-O) Circuitry that acts as a kind of translator between the computer and various input/output devices. Input devices, such as keyboards, and output devices, such as printers, are a computer's way of accepting commands from humans and displaying the results of those commands. I/O controllers manage the communication between such devices and the computer so the CPU is free to perform other tasks. Also called device controllers, you can find I/O controllers of one type or another in diskette drives, hard drives, CD-ROM drives, keyboards, mice, and many other components.

Input/output device—A peripheral device that accepts information for processing and displays output for the user. A diskette drive and tape drive are examples of input/output devices because these peripherals take information from the CPU for storage and send information back in as required.

Input device



Input/output interface—See **input/output controller**.

Input/output port—A port on the outside of the computer where peripheral devices connect to the inside of the computer and the processor.

Input/output processor—A processor, separate from the CPU, that handles only input/output transactions.

Input/output statement—The part of a program that tells the computer to take information to memory from an input/output device or from memory to an output device.

Input port—See **input/output port**.

Insert—To place in between. In computing, it means to place something between data, information, or any other pieces of a document. For example, you can insert words anywhere in a word processing document.

Insertion point—The place where additional information will be included when typing in Insert mode.

Install—The process of setting up a piece of hardware or software for operation. The installation of hardware involves connecting the new component to the rest of the computer, loading any accompanying software on the hard drive, and configuring the computer system so it will communicate with the new device. The installation of software involves loading the program on the hard drive and configuring the software for use with the system.

INSERT key—On a typical keyboard, this is the key users use to toggle between Insert mode and Overwrite mode. Insert mode means any letters you type will appear at the cursor, moving the information behind the cursor farther to the right. Overwrite mode means any information typed at the cursor will write on top of the current information, deleting the old information.

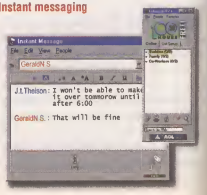
Insert mode—A word processing mode that lets users type additional text without replacing the characters on the page. Overwrite mode types the new text over the information to the right of the cursor. Typically, the INSERT key toggles between Insert mode and Overwrite mode. Compare to **Overwrite mode**.

Installable file system—In short, a file system that can be added to a computer that uses multiple file systems. At length, a file system is the way a computer organizes, manages, and retrieves files from a storage medium such as a hard drive. File systems usually consist of files separated into groups called directories. Directories can contain subdirectories, which in turn can contain still more subdirectories. Most computers have one file system to manage the data on the hard drive, but some computers—especially those that perform a variety of complex calculations and technical operations—rely upon multiple file systems to organize the data in the computer. An installable file system can be added to a computer that uses multiple file systems. A computer that uses multiple file systems can access different types of file structures. See **file system**.

Installation program—The program that executes the necessary steps to set up software for use. The installation program is usually initiated by typing **install.exe** or **setup.exe** at the command prompt. Also called an installer.

Instant messaging—Sending messages to another user that immediately appear on that user's computer screen over a network. Instant messaging can work on inter-office local-area networks (LANs) or across the Internet. Instant messages are different from E-mail messages in that they do not sit unread until the user checks his or her E-mail; they

Instant messaging


Instant Message
File Edit View People
GeraldN.S:
J.L.Theison: I won't be able to make it over tomorrow until after 6:00
GeraldN.S.: That will be fine

appear on-screen as they are received. Instant messaging does, however, require software on both the sender's and recipient's computers. One example of instant messaging software is America Online's (AOL's) Instant Messenger, which can be used by all Internet users, not just AOL subscribers. Instant messaging is handy for urgent communication and short, succinct notes that might not be important enough for E-mail messages.

Institute for Certification of Computer Professionals (ICCP)—An association founded in 1973 for the purpose of testing the knowledge and skills of computer professionals. The ICCP offers a number of certification tests, including tests in computer programming, data processing, and system development, which can be taken at testing sites around the world.

Institute of Electrical and Electronic Engineers (IEEE)—An association of engineers, scientists, and students founded in 1963. The IEEE added developments to the computer and electronics industry, most notably the IEEE 802 standards for local-area networks (LANs). See **local-area network**.

instruction—A basic piece of programming that prompts a computer to execute a function.

instruction set—Sequences of binary programming code (0s and 1s) built into the CPU's memory area and meant to deliver basic sets of commands, such as Find or Save As. Generally, instruction sets range from one to four bytes long.

integral modem—An internal modem built into the basic computer hardware instead of added on through an expansion card.

integrate—As a verb, integrate refers to the action of two or more hardware or software components working together as a system. As an adjective, it means something is a single, conglomerated unit.

integrated circuit (IC)—A package containing many circuits and pathways working together to perform a particular function or a series of functions. Integrated circuits are the building blocks of computer hardware. There are several levels of circuit integration denoting different IC complexities. Also called a computer chip. See **large-scale integration**. See **medium-scale integration**. See **small-scale integration**. See **super-large-scale integration**. See **ultra-large-scale integration**. See **very-large-scale integration**.

Integrated Drive Electronics (IDE)—A standard used since the mid-1980s for connecting hard drives, CD-ROM drives, and tape drives to computers. IDE and its updated successor, Enhanced IDE (EIDE), are based on the original IBM PC Industry Standard Architecture (ISA) 16-bit bus standard. Up to two IDE devices can attach to a single IDE ribbon cable. Many motherboards include built-in support for IDE devices, while others require a separate IDE adapter plugged into an expansion slot. IDE adapters, whether built-in or separate, are relatively simple and inexpensive because IDE devices carry their own controller circuitry. IDE is also known as Advanced Technology Attachment (ATA), while EIDE is sometimes called Fast ATA. IDE differs from the Small Computer Systems Interface (SCSI) standard that is most often on Macintosh computers. SCSI is usually thought of as faster than IDE but more expensive and complicated to use. See **Industry Standard Architecture**. See **Small Computer Systems Interface**.

integrated software

Integrated injection logic (I2L, IIL)—A fast circuit design based on the use of only transistors rather than transistors in combination with resistors. Transistors are like tiny electronic switches. Resistors are found in many circuits where it is necessary to impede the flow of electric current. IIL circuits need very little power to run. See **transistor**.

Integrated power protection system (IPPS)—A device that incorporates an uninterruptible power supply (UPS) system into a computer's power supply. Such devices are handy because they reduce the amount of space required for a computer. See **power supply**. See **uninterruptible power supply**.

Integrated Services Digital Network (ISDN)—A telecommunications network that allows for digital voice, video, and data transmissions. ISDN replaces the slow and inefficient analog telephone system with a fast and efficient digital communications network. ISDN lines contain two channels: a B channel, which has a 64 kilobits per second (Kbps) data transmission rate, and a D channel, which has either a 16Kbps or 64Kbps transmission rate. When the two lines are used together, transmitted data can travel at 128Kbps. Connecting to an ISDN line requires a network terminator and an ISDN terminal adapter. A network terminator prepares a standard telephone line for ISDN data transmissions. An ISDN terminal adapter prepares the computer for ISDN transmissions. ISDN lines are available from most phone companies, but they cost more than your standard phone service. Prices are dropping, however, and ISDN lines may soon become as affordable as other communications services.

integrated software—Software consisting of several applications that work together. For example, one package might include a word processor, a spreadsheet, and a database. The appeal of integrated software is it makes it easy for a recreational computer user to transfer data among the included applications. But the programs in an integrated software package usually do not offer the high-end capabilities of individual, standalone applications.

integrity—The quality of keeping data in its original form and making sure bits and pieces are not inadvertently changed or erased. Integrity most often is compromised by programs gone awry or viruses written to wreak havoc on data. Hardware problems and power failures are less common ways integrity is compromised. See **data integrity**.

intelligence—See smart.

intelligent cable—See smart cable.

Intelligent terminal—See dumb terminal. See smart terminal.

Intensity red green blue (IRGB)—The colors used to make up the images on a 16-color computer monitor. A monitor that uses red-green-blue (RGB) color coding could display eight colors. The addition of an intensity bit, which adjusts the intensity of the three colors, enables the monitor to display up to 16 colors. This technology was used for the color/graphics adapter (CGA), enhanced graphics adapter (EGA), and VGA monitors. See **color/graphics adapter**. See **enhanced graphics adapter**. See **video graphics array**.

Interactive—A quality of a computing device that requires input from a user. Most programs are interactive. Non-interactive programs can run to completion without human input. See **interactive program**.

Interactive graphics—A graphics display controlled by the user. An application that offers interactive graphics might allow a user to adjust the background color or design, for example.

Interactive program—A program requiring user interaction. The computer usually provides the user with a prompt, or request for input. In a graphical user interface (GUI), the selection of icons serves as the prompt. The user responds by using the keyboard, mouse, or other input device. Most programs are considered interactive. Only programs that can complete tasks by themselves without user input are not interactive.

Interactive video—A video-intensive computer program that lets the user control or influence the way the video is played. Interactive video is most often found in games and simulations.

Inter-application communications (IAC)—Applies to the transfer of information between Macintosh applications. Also called an Apple Event.

Interblock gap (IBG)—The gap between blocks of information on magnetic tape backup used to help the microprocessor locate information. Also called an inter-record gap.

Interchangeable file—A file saved in a generic format that several applications can use. An ASCII file is an example of an interchangeable file.

Interface—A communication link in a computer between hardware and software components. A user interface is the way a user communicates with a computer. As a verb, to interface is to communicate. See **user interface**.

Interface adapter—An expansion card that connects a computer to a network. See **network interface card**.

Interface card—See interface adapter.

Inter-IC (I2C)—A bus designed to connect multiple-integrated circuits. The bus has become an industry-wide standard for connecting integrated circuits, primarily in video devices such as computer monitors, televisions, and VCRs. See **bus**. See **integrated circuit**.

Interlacing—A method of refreshing an image displayed on a monitor. Instead of refreshing the entire screen at once, a computer first will refresh the odd-numbered scan lines (horizontal rows of pixels) and then the even-numbered scan lines. This method reduces the amount of new information carried with each refresh sweep while maintaining high quality. Interlacing works well with many applications, but for graphics programs requiring a quick reaction time, flickering or streaking may be visible. Compare to **noninterlaced**.

Interleave—The number of sectors that pass beneath the hard drive's read/write heads before the next sector. The pattern skips several sectors in its sequential rotation because the head does not have time to read them sequentially in its rotational search. By the time a computer finishes reading one sector, the next one in the sequence already has gone by. This is why interleaving marks the next sector to be read, two or three sectors ahead. For example, instead of the sectors reading 1 to 8 in their logical order, they might read 1, 4, 7, 2, 5, 8, 3, 6, 8. This way, a computer always has time to read in order without waiting for the disk to spin all the way around again. Most drives have an interleave factor of one-to-one, which means the system can access a whole track in one revolution. If a drive has an interleave factor of three-to-one, the drive will read one sector and let two pass. Also called sector interleave.

Interleave (in the one-to-one interleave shown, sectors are read sequentially one through eight)

Intermittent error—An error that occurs sporadically. Such an error is difficult to fix because it does not seem to follow a pattern.

Internal clock—See **clock**.

Internal command—A command stored in system memory when the computer is turned on. An operating system does not have room to store all its commands in memory, so it stores the most frequently used commands in memory and leaves the rest in the operating system's directory on the hard drive. Internal commands in DOS include DIR, COPY, DATE, PATH, EXIT, and PROMPT. External commands, such as UNFORMAT, MEMMAKER, and DISKCOPY, are stored on the hard drive. In DOS, the internal commands reside in the Command.com system file. Compare to **external command**.

Internal font—A font included in the memory of a dot matrix, inkjet, or laser printer. All such printers come with at least one built-in font. Users can add additional fonts through software. Also called a built-in font. Compare to **cartridge font**.

Internal interrupt—In contrast with an external interrupt, an internal interrupt originates from within the microprocessor. Interrupts are commands that tell the processor to stop its current task and await new instruction. Some internal interrupts are normal as the processor performs its calculations. Others occur as the result of illegal requests for data or mathematical processing errors. See **interrupt**.

internal memory—See random-access memory.

Internal modem—A modem installed inside the computer via an expansion board. See modem.

internal sort—An organizational process that can take place wholly within main memory. The process is limited to the main memory because all the files being searched are close at hand in RAM. See **random-access memory**.

internal storage—See storage.

International Federation for Information Processing (IFIP)—An international organization whose members include national societies of information-processing professionals. IFIP, which was founded in 1960, includes representative organizations from more than 40 countries, including the Australian Computer Society, the British Computer Society, and the Federation on Computing in the United States (FOCUS).

International Organization for Standardization (ISO)—The Geneva-based body of standards organizations that establishes an international standard for data communications. The ISO, which was founded in 1947, is made up of national organizations from approximately 90 countries. The U.S. representative to ISO is the American National Standards Institute (ANSI). See **American National Standards Institute**.

International Telecommunications Union (ITU)—Founded in 1865, this organization works to further standards in the communications industry. It is composed of three sections: Telecommunication Standardization, Radiocommunication, and Telecommunication Development.

Internet—A global Transmission Control Protocol/Internet Protocol (TCP/IP) network linking millions of computers for communications purposes. The Internet originally was developed in 1969 for the U.S. military and gradually grew to include educational and research institutions. During the last five years, connections to and the use of the Internet have mushroomed. Commercial industries, corporations, and home users all communicate over the Internet, sharing software, messages, and information. Users can access the Internet through commercial online services such as America Online (AOL) or local Internet service providers (ISPs). The most famous aspect of the Internet is the World Wide Web, a system of graphical files saved in a standard format known as Hypertext Markup Language (HTML). Web browsing applications can view such files. Electronic mail (E-mail) is the most popular use for the Internet. See **electronic mail**. See **Transmission Control Protocol/Internet Protocol**. See **World Wide Web**.

Internet II—A forum for scientific study and educational growth, oftentimes specified as the "next-generation Internet." Future projects associated with Internet II include the White House's Next-Generation Internet (NGI) and the National Science Foundation's vBNS collection of universities, corporations, and government entities. The largest part of Internet II is a group of people spanning more than 100 universities who are developing the advanced, global network.

Internet access provider—See **Internet service provider**.

Internet Message Access Protocol (IMAP)—A protocol that lets E-mail users retrieve messages. IMAP performs similar, but expanded, functions compared to Post Office Protocol (POP), which it is replacing. With IMAP, users can examine E-mail messages while the messages are still on the Internet service provider's server and specify which messages to download. IMAP and POP both use Simple Mail Transfer Protocol (SMTP) for sending messages from the user to the mail server. See **Simple Mail Transfer Protocol**.

Internet Protocol address (IP address)—The address of a computer on a Transmission Control Protocol/Internet Protocol (TCP/IP) network. IP addresses are written as four groups of up to three digits each separated by periods. An example is "119.183.115.11".

Internet Protocol Security (IPsec)—This protocol uses the encryption of Internet Protocol (IP) packets to keep the information in them from being read by others. It is most suited to private networks not connected to the Internet. IPsec differs from other methods, such as Secure Sockets Layer (SSL), which encrypts the information in the packets, not the packets themselves. Such security systems require software on both ends to code and decode the messages. With IPsec, on the other hand, the packets are coded and decoded by network hubs and routers, so no special software is required. Instead, changes need to be made only to a few hubs and routers. There are two flavors of IPsec: tunneling and transport. The transport mode encrypts everything but the packet's header (which tells routers where the packet is going). Tunneling, on the other hand, encrypts the entire packet. See **hub**. See **packet**. See **router**. See **Secure Sockets Layer**.

Internet Relay Chat (IRC)—A system that allows real-time text chatting between multiple participants around the world over the Internet. Users log on to any one of many concurrently operative IRC channels dedicated to a variety of topics and talk to one another by typing. Typically a sentence or two is communicated at one time and users read each other's comments as they scroll by on the screen. Joining IRC discussions requires a connection to the Internet and IRC client software. The IRC client sends and receives messages from whatever IRC server is hosting a particular discussion. There are many IRC server computers worldwide.

Internet service provider (ISP)—An organization that lets users pay a fee to dial into its computers and connect to the Internet. ISPs generally provide an Internet connection, an electronic mail (E-mail) address, and perhaps World Wide Web browsing software. You can use an ISP based in your town that offers an access number in your local calling area or a national ISP that provides local-access numbers across the country. You can also connect to the Internet through a commercial online service such as America Online. With this kind of connection, you get Internet access and the proprietary features offered by the online service, such as chat rooms and searchable databases. Internet access through online services can be more expensive than that obtained from an ISP.

Internet telephony service providers (ITSP)—A service that provides telephony through the Internet, allowing users to connect to telephone lines with their PCs. Users can then call among other computers, or simply among telephones. See telephony.

Internetwork Packet Exchange (IPX)—A local-area network (LAN) communications protocol, developed by Novell, that exchanges information between network clients, applications, and network resources (such as printers). See local-area network.

Interprocess communication (IPC)—The ability of applications to share information. An example of IPC is dynamic data exchange (DDE), which is when information modified in one application is automatically updated in another. See dynamic data exchange.

Interrecord gap (IRG)—A break between data records on a hard drive that serves as a safety margin for data overwrites. For instance, if two data sets are stored next to one another on the hard drive, there would be a gap between the data sets to prevent one set from overwriting the other. Also known as interblock gap.

Interrupt—A command that tells the processor to stop what it is doing and wait for further instruction. The interrupt may require the processor to suspend its current job and perform another function. Also called a trap.

Interrupt request lines (IRQ)

0	Timer
1	Keyboard
2	Link to IRQs 8-15
3	COM2, COM4
4	COM1, COM4
5	LPT2
6	Floppy Disk Controller
7	LPT1, LPT3
8	Real Time Clock
9	Redirected IRQ 2
10	Reserved
11	Reserved
12	PS/2 Mouse Port
13	Math Coprocessor
14	Hard Drive Controller
15	Reserved

Interrupt handler—A corresponding routine that is performed whenever an interrupt occurs. Also called an interrupt handling routine or trap handler. Numerous events, such as the arrival of a certain piece of data at a certain place, can trigger interrupt handling routines. Each type of event has its own handling routine.

Interrupt request lines (IRQ)—Communications routes within a computer reserved for carrying interrupt signals, which tell the CPU to halt its current task and await further instructions. Different computer components, such as modems, keyboards, mice, sound cards, and other devices, each have a special IRQ set aside for them to use. These IRQs are prioritized according to the importance of each device, so the most important interrupt requests are handled first. A low IRQ number means an important device will be able to override other devices. For example, the system timer is usually assigned IRQ 0, while the keyboard is often IRQ 1. When a new hardware component is installed into a PC, it may try to use an IRQ setting already in use by another component. This leads to an IRQ conflict, which can cause a variety of errors. To resolve an IRQ conflict, the user may have to reconfigure the IRQ settings either through software or by setting jumper switches on hardware components. Plug-and-Play peripherals are supposed to eliminate IRQ conflicts, although they do not always work. See Plug and Play.

Intranet—An internal network in a single office or throughout a company with several offices. These networks are used to share resources such as laser printers, as well as common files and storage space on file servers. Intranets use the same network technologies, such as Transmission Control Protocol/Internet Protocol (TCP/IP), as the Internet and are often connected to the Internet. Firewalls keep the intranet closed to outsiders while allowing users within the office or company to access the Internet. Intranets have grown increasingly popular because they are much cheaper to build and maintain than networks built on proprietary technologies. See extranet. See firewall.

Intruder—A person or program that enters a computer system without authorization. For example, a virus is an intruder.

Intuitive—A quality describing systems that follow a logical format users can navigate with very little instruction. Part of the reason the Apple Macintosh computer was originally so popular was because its graphical user interface (GUI) is highly intuitive and allows users to open programs and files with a simple point and click of the mouse. Microsoft Windows, including Windows 95, 98, and NT, also use a point-and-click interface similar to that pioneered by Apple. Previous operating systems, such as DOS, were not intuitive because they required users to remember a plethora of commands and complex directory paths.

invalid—Incorrect data for a certain situation. A logical programming flaw or an input error may cause an invalid error. If a computer prompts you for a string of numbers and you input only letters, then you might get an invalid message.

inverse video—See reverse video.

invisible file—See hidden files.

I/O address—See input/output address.

I/O controller—See input/output controller.

IP address—See Internet Protocol address.

IPC—See interprocess communication.

IP faxing—Using the Internet or any other Transmission Control Protocol/Internet Protocol (TCP/IP)-based network to send faxes. Generally, online fax services will strategically place fax machines in cities across the country and use the Internet to transfer faxes across long distances. The faxes are sent over a regular telephone line to a fax machine that is only a low-price local call away from the destination. IP faxing saves money because it virtually eliminates long-distance charges for sending faxes. The technology is very similar to that used to place telephone calls over the Internet.

IPIX—A format for panoramic images. IPIX images offer a 360-degree view—from floor to ceiling and horizon to horizon. Users viewing IPIX pictures press a key or move a mouse to turn, looking to the left, right, or behind them. The images are created by merging two opposing photographs taken

with a fisheye lens (one looking ahead, the other looking behind, for example). Viewing IPIX images requires special free viewer software, standalone applications or, for Web browsers, plug-ins. Such images are handy for documenting places that would otherwise take several images to describe. A picture from NASA's Mars Pathfinder, for

IPIX

example, was presented in a similar, competing format, Apple's QuickTime Virtual Reality (QTVR). Viewers could look around the entire spacecraft, not simply ahead or to the right or left.

IPL—See initial program load.

IPsec—See Internet Protocol Security.

IPX—See Internetwork Packet Exchange.

IR—See information retrieval.

IRC—See Internet Relay Chat.

IrDA—See Infrared Data Association.

IRG—See interrecord gap.

IRGB—See intensity red green blue.

IRQ—See interrupt request lines.

IS—See information systems.

ISA—See Industry Standard Architecture.

ISAM—See indexed sequential access method.

ISDN—See Integrated Services Digital Network.

ISO—See International Organization for Standardization.

ISO Open System Interconnection (ISO/OSI)—See open system interconnection.

Isometric view—A three-dimensional (3-D) view that shows the height, width, and depth of an object, but does not account for changes in the viewer's perspective of the object. In an isometric view of an object, the height, width, and depth of the object are given as they would appear in relation to one another. In a perspective view of an object, the height, width, and depth of the object are given in relation to the person viewing the object. Compare to perspective view.

ISP—See Internet service provider.

ISV—See independent software vendor.

Italic—A style of type that slants letters evenly to the right. For example, *this is in italics.*

Italic Type

Italic

IT—See information technology.

ITSP—See Internet telephony service providers.

ITU—See International Telecommunications Union.

J

jack—A female connector into which a plug is inserted. See female connector. See male connector.

jaggies—Perpendicular lines on the edge of an on-screen image. Jaggies are caused by a monitor resolution setting lower than the one the application requires or by a font or graphic with poor scalability. Also called jags.

Java—A programming language designed to write programs that users can safely

jaggies

downloaded from the Internet to their computers and immediately run without fear of viruses. Using small Java programs (called applets), World Wide Web pages can include functions such as animation, calculators, and other small applications. Java, created by Sun Microsystems, can run on any computer with an installed Java interpreter. Web browsing applications such as Netscape Navigator and Microsoft Internet Explorer include Java interpreters and can run Java applications. See applet.

Java Database Connectivity— An application program interface (API) that allows Java programs to retrieve data from popular database programs such as Microsoft Access. See application program interface. See Java.

JavaScript—A Netscape-developed script language supported by its Navigator Web browsers that allows the creation of interactive Web sites. JavaScript is a relatively simple tool that users should not confuse with Java, a full-fledged programming language developed by Sun Microsystems. JavaScript can, however, be used in conjunction with Java applets. JavaScript is easier to learn and write than Java, and the widespread availability of the Netscape Navigator browser provides one reason for its popularity. Microsoft's Internet Explorer supports a similar scripting language called JScript, but it is more limited in scope. Compare to Java.

JDBC—See Java Database Connectivity.

Jitter—A flickering cursor, signal, or image, on a screen attributable to such ailments as slow refresh rates, poor connections, or hardware problems.

Job—A specified operation completed by the system. A job can be as simple as saving a document or as complex as organizing data into a report.

Job number—An identifying number assigned to each request sent to the CPU in networks and other multiuser environments. Job numbers help the user identify a particular job being held in a buffer, which is a small portion of memory that holds jobs until the device they were sent to is ready for them. The user can check on the status of a job, cancel a job, or identify the job that may have caused a problem. See **buffer**.

Job queue—A reserve where job requests are held until they are sent to the CPU. See **queue**.

Joint Photographic Experts Group (JPEG)—(Pronounced JAY-peg.) A color-image graphics compression format named for the committee that designed the standard image compression algorithm. Using compression, computer files can be altered to take up less storage space. In the JPEG image compression system, some data is sacrificed to achieve high rates of compression. Ratios of 100:1 or higher are possible, which means that a 100 megabyte (MB) graphics file could potentially be reduced to 1MB in length. However, ratios of more than 10:1 or 20:1, depending on the particular image, begin to show noticeable image degradation. The more loss tolerated, the more the image can be compressed. Compression is achieved by dividing the picture into tiny pixel blocks, which are halved again and again until the ratio is achieved. Supported by World Wide Web browsing applications such as Netscape Navigator and Microsoft Internet Explorer, JPEG files end with either the .JPG or .JPEG file extensions. See **data compression**.

Journal—A computer's record of its activities used to reconstruct damage or keep a running log of network activities. See **log**.

Joystick—A peripheral input device shaped like a stick that simulates arcade-like play for computer games. Joysticks are used mainly for computer flight simulators and action games.

joystick

JPEG—See **Joint Photographic Experts Group**.

JScript—A Microsoft programming language, performing a similar function as JavaScript, used to create programs that run inside Web pages, such as news tickers. JScript is used in Microsoft's browser, Internet Explorer. JavaScript is used in Netscape's browser, Navigator. The two standards are not fully compatible, so some scripts will work in one browser but not in the other. See **JavaScript**.

Julian date—A method of expressing the date based upon the number of days in a year. For example, January 1 is 1 and December 31 is 365.

Jumper—An on/off switch, once extensively used on circuit boards to alter hardware configurations, that is composed of wires and a small metal piece. To turn the system on, the metal piece is placed over two of the wires, which connects the wires and makes the circuit complete. When the metal piece is removed from the two wires, the wires do not connect, thus the circuit is not complete and the system is off. Jumpers are found on devices such as CD-ROM interface boards, bus expansion boards, scanner controller boards, input/output cards, sound cards, graphics cards, modem cards (internal modems), and motherboards.

Justified—See **justify**.

Justify—To line up a row of text, either horizontally or vertically. For example, a document that is justified to the left will produce a crisp, clean line of text on the left side of the page; a document that is justified to the right produces an even line of text on the right side of the page. Compare to **rag**.

K—See **kilobyte**.

KB—See **kilobyte**.

Kbps—See **kilobits per second**.

Kermit—A File Transfer Protocol (FTP) that works over phone lines and is noted for its relatively slow speed and high accuracy. Most communications programs allow users to select Kermit as the protocol for a specific transfer or as the default protocol for all transfers. See **File Transfer Protocol**.

kern—A word processing and desktop publishing term that describes the spacing between certain letter combinations. For example, note how in the combination "WA" the two letters crowd together a bit, with the left side of the *A* under the right side of the *W*. Without kerning, a line of type occupies more space and appears less uniform. Users can often adjust kerning.

kernel—The main part of an operating system. The kernel handles the most basic, but most important tasks, such as managing the computer's resources, starting programs, and keeping time. See **operating system**.

key—A single button on the keyboard. Letters, numbers, and symbols are all represented by keys on most keyboards, along with several special function keys (for examples, see the CTRL key and the ALT key). Pressing a key in many applications causes the character on the key to display on the monitor. Also refers to the code used to encrypt and decrypt data. There is also sometimes a physical key that can lock a system.

keyboard—One of the main input devices used by computers, a PC's keyboard looks very similar to the keyboards of electric typewriters. Computer keyboards, however, usually include extra keys such as the function keys, cursor keys, and a number pad.

keyboard buffer—A specific location in a computer's memory where keystrokes from the keyboard are stored until the computer acts upon them. This allows fast typists to continue typing even if the computer is unable to immediately display the letters.

keyboard controller—A small microprocessor built into a keyboard that passes keystroke data to the main computer.

keyboard layout—The physical arrangement of keys on a keyboard. Some computers

allow the keyboard layout to be changed for different languages or typing configurations. Most computer keyboards are laid out in what is called QWERTY format, where the first letters on the top alphabet row are Q, W, E, R, T, and Y. A less-frequently seen, but theoretically more efficient, keyboard design is known as the Dvorak keyboard. See Dvorak keyboard. See QWERTY keyboard.

keyboard layout (Dvorak design)

keyboard repeat—A function of most computers that lets users depress and hold a key and, after a short pause, cause the computer to react as though the user was repeatedly pressing the key. Keyboard repeat is handy if a user wants to type an entire line of a certain character, such as a dash.

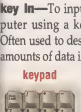
keyboard shortcut—One or more keys that, when pressed together, equal a menu function or other function in an application usually reached through a mouse-click. Keyboard shortcuts usually are not as intuitive as point-and-click mouse commands, but the frequent user of a program can save time by learning them. One shortcut in many programs is CTRL-X, which equals the Cut option found in many Edit menus.

keyboard template—A paper or plastic form placed on top of a keyboard to tell users which keys perform which functions in a program.

keycap—The part of a key on the keyboard seen in normal use. Under the plastic keycap marked by a symbol is the actual key, which is a small switch.

key in—To input information into a computer using a keyboard or numeric pad. Often used to describe the inputting of large amounts of data into a database.

keypad



keypad—A small keyboard holding only numbers and arithmetic keys used for data entry. Numeric keypads occupy less space than full-size keyboards, so they are valuable on small desks when only numeric input is needed.

keyword—When using a search function, a keyword is the word the user wants to find in a document or documents. For example, to find all documents about dogs in a folder, a good keyword might be "dog." Some word processing and database programs let the user attach certain keywords to specific documents to make searching faster; rather than searching the entire file, the search program might only look at lists of user-defined keywords for each file.

KHz—See kilohertz.

kill—To delete or remove data or a file.

killer app—Industry jargon for a computer application that suddenly becomes so wildly popular that it drives other sectors of the industry. Examples are VisiCalc, the original spreadsheet program, and the Web browser, which changed computing by putting a graphical face on the Internet and making it simpler to use.

killfile—In many Usenet newsgroup reading applications, a killfile is a list of names and subjects about which the user does not want to read. The application can automatically remove postings by certain authors, about certain subjects, or containing certain keywords from the listing the user sees.

kilo—A prefix that, in the metric system, stands for 1,000. In computing, where the binary notation system is used, however, kilo- is 2 to the 10th power or 1,024. Hence, measurements not based upon computers, such as kilohertz, use kilo- to represent 1,000, while computing measurements such as kilobits and kilobytes use kilo- to represent 1,024.

kilobaud—A unit of measurement for data transfer using electrical impulses. One kilobaud equals 1,000 baud. See baud.

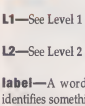
kilobit—Equal to exactly 1,024 bits. Used to measure data storage or transmission in terms of bits, as in kilobits per second (Kbps).

kilobits per second (Kbps)—A unit of measurement for the speed of data transmission; 1Kbps is 1,024bps.

kilobyte (K or KB)—Equal to 1,024 bytes or space enough to store 1,000 characters of information.

kilohertz (KHz)—A measurement of frequency equal to 1,000 hertz (cycles per second). Radio frequencies, for example, are expressed in kilohertz.

kludge, kluge—(Pronounced klooj.) A poorly designed solution to a problem, usually in programming. Also, a computer system made up of poorly matched components.



L1—See Level 1 caching.

L2—See Level 2 caching.

label—A word or group of words that identifies something. A label, in the physical sense, is a sticker, piece of paper, or some type of identifying tag affixed to an object. Labels, in the electronic sense, identify computer files, cells in spreadsheets, and programs. See volume label.

lag—The difference in time between when a user performs a task and the result of that task appears, such as the fraction-of-a-second pause that occurs between the time a key on a keyboard is pressed and when its character appears on-screen. Lag also can mean an image on a computer screen that remains momentarily before the original image changes.

LAN—See local-area network.

Landscape mode—A horizontal print orientation that describes printing across the longest length of the paper. Compare to Portrait mode.

landscape monitor—A horizontal computer monitor that is wider than it is tall. Most computer monitors are landscape monitors. The opposite of the landscape monitor is the portrait monitor, which is taller than it is wide. Compare to portrait monitor.

language—Means of communication that use symbols and predetermined guidelines. In relation to computers, the human language is a natural language, whereas computer language is a machine language. Natural languages are more complex than machine languages. See machine language. See natural language.

language-based interface—See programmatic interface.

language processor—A device that translates directions written in one language into machine code. There are two types of language processors: interpreters and compilers. Interpreters translate and act upon the directions they receive; compilers simply translate the directions.

language translation program—A computer program that translates statements from one language into another. Language translation programs usually deal with high-level languages. For example, such a program might translate C into FORTRAN or the other way around. See high-level language.

laptop computer—A portable computer smaller than a transportable (or luggable), but bigger than a handheld (or palmtop). Most laptop computers are small enough to allow for easy mobility; a battery or an AC power adapter provides the electricity it needs to operate. See portable computer.

large-scale integration—Refers to the consolidation of 100 to 5,000 circuit elements on a single computer chip. Large-scale integration, by its very name, allows more concentration of elements than either the medium- or small-scale integration. See integrated circuit. See medium-scale integration. See small-scale integration.

laser—An intensely focused beam of light. Lasers have many uses, from reading stored optical data (such as on CD-ROMs) to high-quality printing (laser printers). Laser is an acronym for Light Amplification by Stimulated Emission of Radiation.

laser disc (LD)—An 8- or 12-inch-wide disc containing high-quality, full-motion, digitized video and sound read by laser technology.

laser printer—A printer that uses laser technology to print images on paper. The laser re-creates the image on a negatively

laser printer

charged drum. The areas where the laser hits the drum become less charged, which attracts toner, a powdery printing substance. The printer transfers the toner from the drum to paper and applies intense heat to fuse it to the paper. Laser printers print high-quality, high-resolution images, and are faster than inkjet printers, but are also more expensive. See inkjet printer.

laser storage—See compact disc.

latency—The time difference between when a computer issues a request for data from a storage device and when that device finds and delivers the information.

launch—To begin the operation of a program. Today's operating systems have the ability to launch themselves when the computer is turned on. Also used to refer to the release of a new product.

LAWN—See local-area wireless network.

layering—In computer graphics, graphics layering involves working on several layers of a document at a time and then combining the layers to achieve a finished product.

laser

layout—The pattern in which the user places text and graphics on a page when publishing a document such as a magazine. The layout determines which points on a page will draw the eye and receive the most attention. Understanding the principles of good layout is important for producing visually pleasing projects.

LCC—See leadless chip carrier.

LCD—See liquid-crystal display.

LCD printer—See liquid-crystal display printer.

LD—See laser disc.

leader—In typography, the leader is a symbol that leads a reader's eyes across the page. For example, most tables of contents contain leaders, usually a line of periods between a chapter title and the page number on which the chapter begins. In magnetic recordings, the leader is the section of unrecorded tape at the beginning of a reel.

leading—(Pronounced led-ding.) In typography, the distance between two lines of type. To determine leading, measure from the baseline of one line to the baseline of the line above or below it.

leadless chip carrier (LCC)—A method for placing a computer chip on a circuit board. Instead of forcing users to push the chip into the board, the LCC allows the chip and its contacts to sit in a special socket. A clamp secures the chip in place and makes sure the necessary connections occur. See plastic leadless chip carrier.

leaf—A file at the bottom of a hierarchical file system that can have nothing below it. Using a tree structure analogy, the leaves connect to the branches, which connect to the roots.

leapfrog test—A self-copying diagnostic check that tests the capacity of storage media such as diskettes and magnetic tape.

learn mode—A mode in which a computer program learns a sequence of commands. The most common use of the term is in the realm of macro commands. A program in learn mode will record the order in which the user

presses keys, thereby "learning" a specific set of instructions. The sequence can then be stored in memory and activated with a single keystroke, saving time and effort on the part of the user. See macro.

leased line—A telephone line leased by a private individual or company from a telephone company. A leased line should offer the user higher speed and better quality communication capabilities than a typical switched telephone line. Leased lines are used for regular telephone and modem-based communications. Also called a private line.

least significant bit—The lowest bit in a series, located at the far right of a string. Called least-significant because the element on the far right carries the least value. For example, in the decimal system, the number on the far right represents a value between one and nine, while a number in the second spot from the right would represent a number between 10 and 90. Therefore, the far-right number is a lower value.

least significant character—The lowest character in a string, located at the far right of a string. See least significant bit.

least significant digit—The lowest digit in a number, located at the far right of a string. See least significant bit.

LED—See light-emitting diode.

LED printer—See light-emitting diode printer.

left justify—A page format that aligns text along the left side of the page. This layout has a ragged right edge and a straight left edge. Compare to right justify.

legend—A graphic located within another graphic that explains icons used in the presentation. For example, a map of the United States might include a legend that identifies which symbols stand for state capitals.

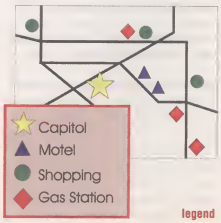
legacy—Old software, hardware, or data that is still in use. Legacy software can be old mainframe programs that are no longer supported and/or those that only ran on outdated systems. With the growth of the installed base of Windows 95 and 98, legacy software now often refers to DOS or Windows 3.x software in use on Windows 95/98 systems, as well. Legacy hardware usually refers to old Industry Standard Architecture (ISA) expansion cards, manufactured before 1994 that do not support the ISA Plug-and-Play standard. These cards usually work on newer computers, but often require extra work to configure and setup. Legacy data refers to data stored in a format no longer in use, especially from now-extinct mainframe programs. Legacy data can also be data stored on a medium, such as 5.25-inch diskettes that are no longer standard. There are even legacy protocols, which are network protocols that have become obsolete thanks to the ascendance of Internet Protocol (IP). AppleTalk would be an example of a legacy protocol.

letter quality—A quality of print equal to or better than what a standard electronic typewriter can produce. Laser and inkjet printers both produce letter-quality type, while a dot-matrix printer produces near-letter-quality type.

letter-quality printer—A printer that produces a print quality that can be used in a professional capacity, such as for a resume. See letter quality.

Level 1 caching (L1)—In advanced microprocessors, frequently accessed data and machine instructions that can be held internally in cache memory until they are no longer needed. L1 caching makes microprocessor operation much more efficient. See cache. See Level 2 caching.

Level 2 caching (L2)—Additional cache memory that can be accessed more quickly than the primary cache. Typically external, the L2 cache is generally located on a separate chip or an expansion card. This additional memory is used to supplement the small Level 1 (L1) memory available to the CPU. See cache. See Level 1 caching.



legend

lexicographic sort—An alphabetical listing of items. Numbers appear in a lexicographic sort according to their spelling.

lexicon—In relation to computers, the words and definitions that make up a programming language.

lexicon

LF—See linefeed.

library—A collection of files, programs, routines, or functions.

license agreement—A packet of legal paperwork that allows users to purchase the use of a software company's product. It does not transfer ownership. Most license agreements appear on a software's package, and when the package is opened, users agree to the terms listed.

LIF socket—See low-insertion force socket.

ligature—A combination character used with some fonts when two regular characters appear next to each other and bump against each other. For example, a publisher may replace the letters ff with a ligature that connects the short line in the middle of the characters.

light bar—A highlighted item on a computer screen that will appear with a different color to make it stand out from the rest of the screen.

light-emitting diode (LED)—A special type of semiconductor that illuminates when an electrical charge passes through it. LEDs are usually red; manufacturers often use them for readouts on electronic devices such as alarm clocks.

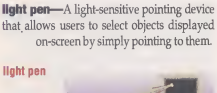
light-emitting diode (LED) printer—A printer that produces high-quality images using a method similar to laser printing, but which replaces the laser with a light-emitting diode (LED) panel. The LED panel recreates the image on a negatively charged drum. The areas where the light hits the drum become less charged, which means these areas attract toner. The printer transfers the toner from the drum to a piece of paper and applies intense heat to fuse the toner to the paper.

light guide—A piece of equipment that transmits light from one point to another. Fiber-optic cables are light guides.

Light Intensity Modulation Direct OverWrite (LIMDOW)—An improvement to magneto-optical drives that allows data to be written at speeds of up to four megabits per second (Mbps), twice as fast as standard magneto-optical drives. By modulating the intensity of the laser, LIMDOW drives can write data in one pass instead of two; older drives required one pass to erase the sector to be written to and another to write the data to it. See **magneto-optical drive**.

light pen—A light-sensitive pointing device that allows users to select objects displayed on-screen by simply pointing to them.

light pen



lightwave system—A communication system that transmits pulses of light from one location to another. For example, some telephone companies have fiber-optic cables that transmit information-laden light pulses from one user to another.

Li-Ion—See **Lithium-Ion battery**.

LIM-EMS—Abbreviation for Lotus/Intel/Microsoft Expanded Memory Specification (EMS), a memory-paging technique designed to add memory to IBM PC systems. The three computer industry giants collaborated to create this software solution to DOS' early memory limitations. LIM-EMS bypasses DOS' one megabyte (MB) maximum amount of usable memory by supporting memory boards containing RAM banks, which means they are essentially swapping pages between expanded memory and memory accessible to the operating system. See **expanded memory specification**.

LIMDOW—See **Light Intensity Modulation Direct OverWrite**.

limiting operation—A single process that slows the larger operation of which it is a part. For example, a slow spell checker can slow down an entire word processing program.

line—A connector between two points. A line can be many things: In communications, a wire that connects two devices and allows a signal to pass between them is a line. In programming, a line is a single row of symbols; in a word processing program, a row of characters forms a line.

line adapter—A feature that converts a digital signal into a form for transmission over a line. A modem is one type of line adapter; it transforms the digital signal from a computer into an analog signal for the phone line. See **digital**.

line analyzer—A device used to test the quality of a communications line. See **communications line**.

linear—An adjective that commonly describes anything occurring in a specific order. For example, terms in a dictionary typically appear in alphabetical order, which is a kind of linear pattern. In computer programming, linear refers to two variables or elements that are evenly related.

linear inferences per second (LIPS)—A measurement tool that identifies how fast an artificial intelligence (AI) program can think. See **artificial intelligence**.

linear search—A computing search method that examines each item, one at a time, in sequence, until it locates the specified element. A linear search is a very thorough, but slow, search method. It can be compared to reading every entry in a dictionary until you find the one you want, as opposed to flipping to the letter with which the word begins and searching for it there.

line art

line art—A graphic created entirely of distinct lines, with no shading.

line caps—The way the ending of a line segment appears when printed. There are several styles of line caps, such as rounded and square. Usually refers specifically to PostScript-compatible printers and how they print line segments. See **PostScript**.

line conditioning—An improvement made in a communications line to increase the quality of its transmissions. Conditioning reduces the degree of distortion in a line and boosts weak signals. See **communications line**.

line drawing—A simple drawing composed only of lines with no textures.

line driver—A device that boosts the strength of a signal before sending it down a line. A line driver increases the transmission distance, which helps to ensure the signal reaches its destination.

line editor—See **editor**.

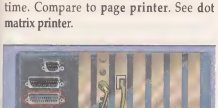
linefeed (LF)—A computer code that tells the on-screen cursor to advance to the same location on the next line down. In some operating systems, this indicates the end of a line of text. In printing, linefeed is a function usually represented by a single button that advances the paper in a printer by one line. See **cursor**.

line frequency—The number of times a signal travels over a communications line in one second. Also used as another term for lines per inch. See **communications line**.

line level—The measure of a signal's strength as it is carried on a communications line, gauged at a specific point on that line. Line levels are given in decibels or nepers. (A decibel is the volume or strength of a signal; a neper is a ratio that

represents roughly 8.86 decibels.) They can vary greatly from one point in a line to the next. See **communications line**.

line printer—A high-speed printer, usually connected to a large computer system, that has the ability to print an entire line of text at once instead of just one character at a time. Compare to **page printer**. See **dot matrix printer**.



line printer terminal

line printer terminal (LPT)—A designation derived from the days of the control program for microprocessors (CP/M) and Microsoft DOS (MS-DOS) operating systems to identify parallel ports that connect computers to printers. DOS and Windows assign the names LPT1, LPT2, and LPT3 to the first three parallel ports installed on a computer. LPT ports, with the correct cables, can also be used to connect two computers together, as with Windows 95's Direct Cable Connection utility.

line spacing—See **leading**.

line speed—The amount of data you can send through a communications line at one time. Data speeds are often measured in bits per second (bps).

lines per inch (LPI)—In printing, the number of lines that appear within a vertical inch in a grayscale or color image. A higher number of lines per inch means the image will be smoother, just as a higher number of dots per inch means a clearer resolution on a monitor.

line surge—A large, unexpected increase in the amount of energy carried in a power line. A surge can damage unprotected computers. See **surge protector**.

lines per minute (LPM)—The number of lines of text a printer can output in one minute. Printing mode (draft compared to high quality, for example), the type of program used, and the size of type all can affect print speed.

link—As a noun, refers to a connection between two objects. In data management, a link allows information sharing between a source document and a destination document. Information a user changes at the source also changes at the destination in linked documents. In communications, a link is the line through which data is transmitted. In programming, a link is a connection to another program. On the Web, a link (short for hypertext link or hyperlink) is a connection that takes users to another page. As a verb, refers to the act of connecting two devices or programs.

link time—The time it takes a program to link to another program. See **link**.

Linux—A freeware version of the Unix operating system, originally developed by Linus Torvalds at the University of Helsinki in Finland. Torvalds developed the core, or kernel, of the operating system. The rest of the operating system was filled out with a horde of software, including Unix system staples such as the emacs editor and a full library of compilers from the Free Software Foundation's GNU project. There are now several different versions of Linux available, including RedHat and MkLinux. While Linux is available for free, some versions, such as RedHat, are commercially distributed. Linux has developed a reputation as an especially fast and efficient operating system. Some pundits see it as a possible alternative to the Windows operating system, but it still lags far behind Windows in the number of consumer users. See **operating system**.

LIPS—See **linear inferences per second**.

liquid-crystal display (LCD)—A flat, lightweight display technology used in calculators and laptop computers. Special molecules in the screen have the ability to bend and twist light to create desired images. There are monochrome LCD displays, which appear gray, and there are color LCDs. The three basic types of LCD displays are passive-matrix, dual-scan, and active-matrix. Active-matrix displays look the best, but they are much more expensive than dual-scan and passive-matrix displays. See **active-matrix display**. See **dual-scan display**. See **passive-matrix display**.

liquid-crystal display (LCD) printer—Produces high-quality images using a method similar to laser printing, but replaces the laser with an LCD and a halogen light source. The display projects the image onto a negatively charged drum. The areas where the light shines through the display and hits the drum become less charged, which attracts toner (a powdery printing substance). The printer transfers the toner from the drum to a piece of paper and applies intense heat to fuse the toner to the paper.

LISP—See **list processing**.

list—As a noun, data that appears in a logical, linear formation. As a verb, it means to set data in this logical, linear format.

list box—A list contained in a pop-up window or dialog box. Also called a **picklist**.

list processing (LISP)—List processing is a type of high-level programming used in artificial intelligence (AI) research.

Listserv—A mailing list server developed in 1986 that became the de facto standard for mailing lists. The original program is now owned by L-soft, but the term is often used generically to refer to any mailing list server. Listserv, and programs like it, manage mailing lists. They distribute messages to the list's subscribers as well as handle subscribe and unsubscribe requests, and commands from the list owner. See **mailing list**.

literal—A number or instruction that remains constant and unchanged, even when translated into the machine language used by computers.

lithium-ion battery (Li-Ion)—Batteries able to produce considerably more charge than comparably sized nickel-metal hydride batteries. Li-ion batteries often are used in quality portable computers. Compare to **nickel-cadmium battery**. See **nickel-metal hydride battery**.

liveware—Slang used to describe a person who uses a computer. A computer is the hardware, programs are the software, and the user is the liveware.

load—To begin the operation of a program by moving necessary information from a diskette or hard drive into a computer's memory.

loader—A program utility that moves a program from storage into memory, where it can begin operation.

loadhigh—A DOS utility (5.0 or newer) that lets you place some DOS functions into upper memory to preserve space in conventional memory. See **conventional memory**. See **upper memory**.

load point—The area on a magnetic tape where information storage begins.

local—Describes a close-by operation or system. A user does not have to access a local system through a network or other communication line; all the necessary files and operations are within the system. This is different from local-area networks (LANs), which use communication lines, but are located near each other. Compare to **remote**.

local-area network (LAN)—A group of computers, usually in one building or office, physically connected in a manner that lets them communicate and interact with each other. For a network to operate, it needs a server, which is a computer that holds data used by the different computers on the network. Some of the benefits of a network connection include the ability to share document files and expensive equipment, such as laser printers. Networks can be connected using different combinations of topologies, protocols, software, and hardware. Compare to **wide-area network**.

local-area wireless network (LAWN)—A network that uses radio transmissions instead of cables to connect computers. A LAWN shares many capabilities with a local-area network (LAN). See **local-area network**.

local bus—A bus (pathway) on a computer motherboard that allows a more direct access path to the processor for a limited number of devices. For example, a video card plugged into a slot in the local bus should produce good video playback because it has a direct connection to the microprocessor. Most new computers have both a local bus and a regular expansion bus. See **bus**. See **Peripheral Component Interconnect**.

local-bus protocol—The protocol that allows the local bus, an information transportation line between CPUs, RAM, and peripherals, to actually serve as the area of information transport. See **local bus**.

local bypass—A telephone connection that does not require a transfer through a telephone company.

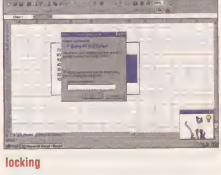
localization—A change in a program made so it will work better for a specific group or function. For example, localization might include changes that take into account a different language, such as Japanese. One such change might be translating commands in menus from English to Japanese.

location—See **address**.

local memory—Memory located on the same bus or card as a given processor in a system with more than one processor. Memory that is local to one processor generally is inaccessible to another.

locked file—A computer file that cannot be altered. Normal users of such files cannot alter the information they contain, change their location, or alter their names.

locking—A process that allows one person at a time full access to files contained in a network database. Locking prevents



locking

two people from trying to make changes on the same file at the same time. In most situations, a second user may view the file, but only the first one can make content changes.

lockout—A quality that protects a file in a network database from being altered by more than one person at a time by denying the second party access to it. See **locking**.

lock up—When a program has ceased to operate correctly, everything on a monitor's display may "freeze" and no response to keyboard and mouse input can be observed. This often can be remedied by rebooting (restarting) the computer, although information in open applications may be lost. Also known as a hang. See **reboot**.

log—A detailed list of a system's or application's activities. A log can be useful for keeping track of computer use and emergency recovery of data.

logic—A list of instructions that tells a program or circuits in a piece of hardware how to operate. Also, logic is the use of deductive reasoning and mathematic formulas to test the validity of a hypothesis.

logical—A computer solution based upon true or false answers, instead of numeric values. Logical can also refer to "virtual" devices, which are devices that are immaterial. For example, a hard drive partitioned into two areas creates two logical drives on one physical drive. Compare to **alphanumeric**. Compare to **numeric**. Compare to **physical**.

logical decision—A computer-related decision that can have one of only two possible results. Possible pairs of results include true/false and yes/no.

logical device—The name of a device granted by the operating system. One physical device, such as a hard drive, may comprise more than one logical device. For instance, a single hard drive divided into two partitions might be known to the computer as both Drive C and Drive E. A logical device might also be the name for a virtual device. See **virtual device**.

logical operator—A binary operator that deals with yes/no and true/false values. Common logical operators include AND, OR, and NOT. See **Boolean**.

logic bomb—An error in the logic of a program routine that results in the destruction of

data. Unlike a virus, logic bombs do their damage immediately, then stop. Also, logic bombs are unintentional and can be the result of a simple corrupt file.

logic chip—A processing chip. A logic chip is different than a memory chip. See memory chips.

logic circuit—A circuit that performs a processing or controlling function in a computer, in contrast to memory circuits which merely store data.

logic error—A problem in a program that causes it to operate incorrectly, but not to fail. Because a logic error will not cause the program to stop working, it can produce incorrect data that may not be immediately recognizable.

logic-seeking printer—A printer with the ability to "think ahead" to the next line it will print so it can operate as efficiently as possible. For example, a logic-seeking printer will skip sections of empty space rather than "print" the spaces.

login—The process users must complete to gain access to a computer, network, bulletin board system (BBS), online service, or Internet service provider (ISP). Logging in usually involves typing one or more passwords. Also called logon. See sign on.

LOGO—(Pronounced low-go.) A high-level programming language known for its graphics capabilities, created by Seymour Papert in the mid-1960s. Also known as turtle graphics.

logoff—The process for ending a session with a computer network, bulletin board system (BBS), online service, or Internet service provider (ISP). Also called logout. See sign off.

logon—See login.

long-haul—A communications device, such as a modem, that can transmit and receive signals from distances of more than one mile. Most modems are long-haul modems. Compare to short-haul.

longitudinal redundancy check (LRC)—The process used for verifying the accuracy of stored or transmitted data. LRC uses an additional bit added to a data stream (a parity bit) to check to make sure all data is present. See parity. See parity bit.

look-and-feel—Describes the way an application appears and functions.

loop—The process in which a program repeats the same instructions over and over until it receives the order to stop.

loop configuration—A communications link that transmits data from one linked station to the next, covering the entire loop.

loophole—A programming mistake, often caused by the programmer's inability to anticipate every situation that might occur.

lo-res—(Pronounced low-rez.) A slang term for low resolution. See low resolution.

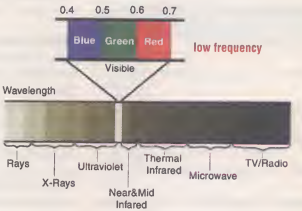
lossless compression—A method of file compression that loses no data during the compression or decompression process. Lossless compression most often is used for executable and other files that require all their data to function correctly. Lossless compression standards provide the highest quality images with lower amounts of compression. For example, Huffman coding is a lossless data compression algorithm used in image compression. Compare to lossy compression.

lossy compression—A data compression method that sacrifices some information to achieve greater compression. Lossy compression methods are used most often for graphic and audio files. Such files may lose a bit of quality during the process, but they usually remain understandable and take up far less storage space. An example of a lossy graphic compression format is the Graphics Interchange Format (GIF). Compare to lossless compression. See Graphics Interchange Format.

lost cluster—Part of an information cluster (a unit of storage) that has broken loose from its chain, usually during a hardware crash. Lost clusters take up space on the disk and make the computer think they are in use when they are not.

lowercase—Letters that take the form of a, b, c as opposed to A, B, C. The first letter of each sentence is uppercase. Programs that distinguish between uppercase and lowercase letters are "case sensitive." Compare to uppercase.

low frequency—The range of radio frequencies between 30 kilohertz (KHz) and



300KHz in the electromagnetic spectrum. Several types of radio transmission use the low frequency spectrum to send their signals. See kilohertz.

low-insertion force (LIF) socket—A Socket 7 subtype that requires little force to insert or remove a processor, thereby reducing the chance of damage. LIF sockets generally require a special tool or a screwdriver to pry the microprocessor from the socket. LIF sockets still require more force than Zero Insertion Force (ZIF) sockets, which do not require any force for the installation of a microprocessor. ZIF sockets include a built-in handle. They are used on most Pentium processors, while LIF sockets are more common on 486 and 386 series computers. See Zero Insertion Force socket.

low-level format—The initial formatting of a hard drive, when the drive creates physical tracks in the surface of the internal disks. The drive manufacturer usually performs the low-level format. This prepares the disk for a high-level format that the end user performs. Compare to high-level format.

low-level language—Basic programming language such as assembly and machine languages. This very simple language is the opposite of the more complex and abstract natural languages of humans. See **high-level language**. See **machine language**.

LPI—See **lines per inch**.

LPM—See **lines per minute**.

LPT—See **line printer terminal**.

LRC—See **longitudinal redundancy check**.

LS-120—The disk format used in SuperDisk drives and diskettes. See **SuperDisk**.

LSB—See **least significant bit**.

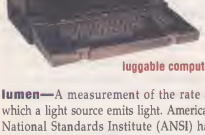
LSC—See **least significant character**.

LSD—See **least significant digit**.

LSI—See **large-scale integration**.

L

luggable computer-The early generation of transportable computers that usually had a cathode-ray tube (CRT) display, as opposed to a liquid-crystal display (LCD), which is found in most laptop and notebook computers today. Luggable computers weighed 15 to 30 pounds, and have been replaced by laptop and notebook computers, which are smaller and easier to use. See **cathode-ray tube**.



luggable computer

lumen—A measurement of the rate at which a light source emits light. American National Standards Institute (ANSI) has developed a more-refined measurement called the ANSI lumen, used to measure the brightness of overhead projectors. The ANSI lumen measures the brightness at nine points on the projector lens instead of one. Projectors with a "hot spot," or bright center and dim edges, will have a relatively high number of lumens but a low number of ANSI lumens. Good projectors should have nearly equal numbers of lumens and ANSI lumens. The number of lumens or ANSI lumens can also be used to determine how powerful of a projector is needed for certain tasks. For example, a projector would need only 450 lumens in a small meeting room, but would need over 1,000 for a large room or auditorium. See **American National Standards Institute**.

luminance—The brightness of a computer screen, controlled by part of a composite video signal. Also used to describe part of the signal that defines the brightness.

lurking—Reading online messages or chat room conversations without taking part in the discussion. Users new to online newsgroups, mailing lists, or chat rooms are encouraged to lurk for a while until they know what the discussion is about. This prevents the same questions from being asked over and over as new users discover the area. In addition to lurking, new users are encouraged to read FAQs.

M

M—See **mega-**.

Mac—Slang for Macintosh computers. See **Macintosh**.

MAC—See **medium access control**.

machine address—See **direct address**.

machine code—See **machine language**.

machine cycle—After the CPU is given a machine language instruction, which is the programming code a computer reads and interprets, it carries out four steps in its cycle: fetch, decode, execute, and store. See **decode**. See **execute**. See **fetch**. See **store**.

machine-dependent—Designed to operate on a specific computer. Compare to **machine-independent**.

machine error—A hardware error as opposed to a human error.

machine-independent—Able to be used on different computers with very little change or none at all in performance and functionality. Compare to **machine-dependent**.

machine language—The binary-encoded programming a computer reads and interprets. Machine language is the only way to communicate with a computer; all instructions must be translated into machine language. Also called computer instruction code. See **programming language**.

machine-readable—Describes information in a form a computer can read. Examples include files stored on diskette and printed text if the computer uses optical character recognition (OCR) software. Systems with bar code-reading hardware and software can read printed bar codes.

Macintosh (iMac)

Macintosh—Designed by Apple Computer Inc. and introduced in 1984, the Macintosh is a computer known for its easy-to-use graphical user interface (GUI) that uses icons, windows, and a mouse for point-and-click operation. Programs written for the Macintosh cannot be used on IBM-compatible PCs and vice versa. However, in recent years, an effort has been made to bridge the gap. In 1994, the PowerPC microprocessor was implemented in newer Macintoshes, part of a joint venture among Apple Computer, IBM Corp., and Motorola Corp. This new architecture is a step toward a universal operating system (OS). PowerPC Macintoshes can read IBM-formatted diskettes, and many applications, such as Microsoft Word for the Macintosh, can convert files created by their Windows equivalents.

macro—A series of keyboard and mouse actions recorded to a single key, symbol, or name. Macros are helpful when you perform a task often. See **programmable function key**.

macro recorder—A program used to record a series of keyboard and mouse

actions into a single macro. A user will record a complete series of actions and then assign a single key, symbol, or name to the series. See **macro**.

macro virus—A virus that travels as a macro embedded in documents, especially Microsoft Word and Excel documents. Such viruses remain dormant until the infected file is opened. Then, if the virus is malicious, the virus may damage other files, perform a prank, or infect other files. One macro virus, Atom, will delete all files in a directory. Others are more benign, simply attaching their code to documents. Once an infected file is opened, the virus will usually infect all files that are opened afterward until the virus is removed by software that disinfects the appropriate template file. Macro viruses are quickly spread through E-mail messages or shared files. Antivirus scanning software should be used and updated so macro viruses can be caught before they infect a system.

magnetically charged ink—Computers equipped with the appropriate hardware can read the characters printed in such ink. This method is used to read account numbers off bank checks.

magnetic card—A thin flexible card that stores information on a coating of magnetic oxide. For example, most credit cards include a magnetic strip. A special reader device then obtains the information stored on the card. See **magnetic card reader**.

magnetic card reader—A device that can retrieve stored information from a magnetic card. For example, automatic teller machines contain magnetic card readers. See **magnetic card**.

magnetic disk—See **diskette**.

magnetic-Ink character recognition (MICR)—A type of character recognition using magnetically charged ink. Computers equipped with the appropriate hardware can read the characters printed in such ink. This method is used to read account numbers off bank checks.

magnetic media—Any type of storage medium, such as tapes and diskettes, in which magnetic patterns represent stored values.

magnetic oxide—See **ferric oxide (FeO2)**.

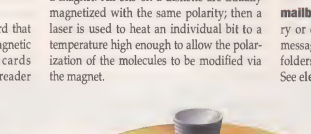
magnetic storage—Holding information on tape, diskette, or other form of magnetic media using different patterns of magnetization.

magnetic tape—See **tape**.

magneto-optical disk (MO diskette)—Diskettes used in a magneto-optical drive that can be read from and written to. See **magneto-optical drive**.

magneto-optical drive (MO drive)—Combines the qualities of magnetic diskette drives and CD-ROM drives and features the read and write capabilities of magnetic drives as well as the higher storage capabilities of CD-ROMs (more than 200 megabytes [MB]). MO drives access data more rapidly than magnetic and CD-ROM drives.

magneto-optical recording—A way of recording information using both a laser and a magnet. All bits on a diskette are initially magnetized with the same polarity; then a laser is used to heat an individual bit to a temperature high enough to allow the polarization of the molecules to be modified via the magnet.

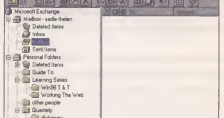


magnetoresistive head (MR)

magnetoresistive head (MR)—A type of read/write head that enables the creation of larger, faster hard drives by separating the read and write functions onto two separate heads. Older hard drive technologies used a single head for reading and writing. Older drive technology is limited to an areal density of about 1.3 gigabytes (GB) per 3.5-inch drive. MR drives, on the other hand, quickly broke that barrier with an areal density of three gigabits (Gb) per square inch. Giant magnetoresistive heads, currently under development by IBM, exploit the quantum characteristics of electrons and may soon achieve areal densities of 10 gigabits per square inch. See **areal density**. See **hard drive**. See **head**.

mail—See **electronic mail**. See **snail mail**.

mail bomb—When someone transmits mass amounts of E-mail messages and attachments, either unintentionally or maliciously, and clogs a single recipient's mail system or an entire network. See **electronic mail**.



mailbox

mailbox—A storage area, either in memory or on disk, for electronic mail (E-mail) messages. This area is usually divided into folders, notably Inbox and Outbox folders. See **electronic mail**.

mail exploder—A type of program that forwards an electronic mail (E-mail) message to multiple addresses. See **electronic mail**.

mailing list—Internet discussion groups that link people with common interests together. If you belong to a mailing list, you receive every message posted to that list via the Internet's electronic mail (E-mail) system. See **electronic mail**.

mail merge—The ability of some word processing applications to automatically insert a list of addresses and other information into form letters. The user sets up a document laced with special codes indicating where addresses and names will be inserted. This document is then combined with a list of names and addresses. The results can be printed or stored as separate files. Mail

merge saves the user the hassle of repeatedly typing the same text. Also called print merge.

mail reflector—An electronic mail (E-mail) account that follows a program to automatically distribute incoming mail to a list of addresses. Sending a message to the reflector is like sending it to everyone on the reflector's list. This system is often used in mailing list discussion groups. See **mailing list**.

mail server—A computer that holds electronic mail (E-mail) messages for clients on a network. Also refers to a program that distributes messages to individual members of a mailing list. See **electronic mail (E-mail)**. See **mailing list**.

mail transfer agent—Software responsible for the delivery of electronic mail (E-mail). The transfer agent gets E-mail from a user agent or another transfer agent and then delivers the mail or routes it to another transfer agent. See **electronic mail**. See **mail user agent**.

M

mail user agent—Software used for access and management of electronic mail (E-mail). The user agent receives incoming mail from, and delivers outgoing mail to, a **mail transfer agent**. See **mail transfer agent**.

Main—A program group in the Windows 3.x Program Manager that contains the features needed to manage Windows, including File Manager, Control Panel, and Windows Setup.

mainframe—A large central computer with lots of memory, storage space, and fast microprocessors that handle all the processing and storage for a group of dumb terminals. See **dumb terminal**. See **microprocessor**.

main memory—See **random-access memory**.

majordomo—A type of software designed to manage interest groups and discussion and mailing lists on the Internet. Majordomo does not deliver the mail, but it organizes it and takes care of basic management such as formatting and archiving messages. See **mailing list**.

male connector—One of two types of cable connectors, the male connector has pins that fit into the receptacles of the female connector. Compare to **female connector**.

MAN—See **metropolitan-area network**.

management information system (MIS)—Data processing that provides an organization's management with information necessary for supervisory tasks, such as creating schedules and evaluation procedures.

male connector

manual—A book or a computer program that contains a set of instructions about how to use a piece of software or hardware. Most computer products are sold with some sort of user manual included in the package; manuals written by third parties can be obtained from retailers of book and computer products. In many cases, the third-party manual can contain more tutorial and troubleshooting information than the manual that was provided by the manufacturer.

map—As a verb, the reproduction of a set of values from one place to another. As a noun, a file that shows the structure of a program, such as a map file, which breaks down a program into its individual characters.

MAPI—See **messaging application programming interface**.

mark—A tag that draws the user's attention to a certain item in a list or a folder. For example, in an online newsgroup, you can mark any messages you might want to save or read in the future.

markup—Characters or symbols used to change the format of text in word-processing files and Web pages. The markup tags for Web pages, in Hypertext Markup Language (HTML), such as the tag for a new paragraph, <P>, are fairly straightforward and can be manually written and edited. Markup symbols for word processors, on the other hand, are more complex, and usually can not be manually written. Like HTML, they control everything from font size to indents. The tags are transparent if Web pages are opened in a Web browser or word-processing files in the word processor. To see the tags themselves, open the files in a text editor. See **Hypertext Markup Language**.

mask—A filter that holds back certain data and allows other data to pass. For example, when defining numeric fields for a spreadsheet, parameters can be set to disallow certain values that are too high or too low.

mass storage—Describes techniques for holding large quantities of data. Data stored on mass storage devices, including tapes, diskettes, or CD-ROMs, can be retrieved at a later date. See **data**.

Massachusetts Utility Multi-Programming System (MUMPS)—A programming language most frequently used for manipulating data in medical databases. MUMPS was developed in 1966 at Massachusetts General Hospital and is still used today in hospitals across the world. The language is also known as M.

master boot record (MBR)—A small program used to determine which partition a computer will boot from. The MBR tells the computer where to find and how to load the operating system. It also tells the computer how the hard drive is organized and provides information about the drive's partitions. The master boot record is located on the first sector of the hard drive; it's the first program the computer runs after performing a memory check and looking for a bootable diskette in the diskette drive. The MBR is susceptible to boot sector viruses that can corrupt or delete the MBR, which can leave the hard drive unusable and prevent the computer from booting up. See **boot sector virus**.

master/slave arrangement—A situation in which one apparatus controls others plugged into it. For example, a computer (master) controls a printer (slave).

math coprocessor—A coprocessor that helps a microprocessor perform mathematical calculations. With its assistance, computation-intensive programs, such as spreadsheets, calculate faster and perform better. Math coprocessors are especially useful for

floating-point operations in which large numbers are represented in a small space and calculated quickly, because CPUs cannot process that type of math operation. The math coprocessor can be built into the CPU, as in the Intel 80486DX, or installed separately, as with computers based on Intel's 80386 and 80486SX CPUs. See **floating-point coprocessor**.

matrix—A two-dimensional display of rows and columns used to organize and compare data. For example, a spreadsheet uses a matrix.

maximize—Enlarging a window to its maximum size, usually filling the screen. The maximize button in Windows 95, Windows 98, and Windows NT contains a small box with a thick line at the top. After maximizing a window, the maximize button's image changes to resemble two windows cascading over one another. Clicking this button returns the window to its nonmaximized size. The maximize button in Windows 3.x contains an arrow pointing up. See **restore**.

maximize button—See maximize.

maximize icon—See maximize.

Mb—See megabit.

MB—See megabyte.

Mbps—See megabits per second.

MBR—See master boot record.

MC—See megacycle.

MCA—See micro-channel architecture.

MCGA—See multi-color graphics array.

MDA—See monochrome display adapter.

mean time between failures (MTBF)—The estimated time before a system breaks down. Often measured in thousands of hours.

mechanical mouse—One of three types of computer mice, a mechanical mouse contains a metal or rubber ball on its underside. When the ball is rolled, sensors inside the mouse detect this motion and move the on-screen mouse pointer accordingly. See **optical mouse**. See **optomechanical mouse**.

media—The plural term for computer storage material such as diskettes, hard disks, and tapes.

medium access control (MAC)—The protocol that determines the transmission of information on a local-area network. See **local-area network**.

medium-scale integration—An integrated circuit that contains between 30 and 1,000 electronic components on a single chip. See **integrated circuit**.

meg—See megabyte.

mega—A prefix that denotes 1 million. In reference to computers, it is two to the 20th power (1,048,576).

megabit (Mb)—Approximately 1 million characters of information (1,048,576) that usually expresses the rate at which data are transferred.

megabits per second (Mbps)—A measurement used to determine the amount of data being transmitted per second on a network or modem. See **data**.

megabyte (MB)—A common measurement of computer storage equaling 1,048,576 bytes. Also called a meg.

MBpm—See megabytes per minute

mega

Prefix	Metric: 10^n	Expanded Metric Notation	Computing (Binary Notation): 2^n	Expanded Binary Notation
giga	10^9	1,000,000,000	2^{30}	1,073,741,824
mega	10^6	1,000,000	2^{20}	1,048,576
kilo	10^3	1,000	2^{10}	1,024
hecto	10^2	100	2^7	128
deka	10^1	10	2^4	16
deci	10^{-1}	0.1	2^{-1}	0.5
centi	10^{-2}	0.01	2^{-4}	0.0625
milli	10^{-3}	0.001	2^{-7}	0.0078125
micro	10^{-6}	0.000001	2^{-20}	0.000000095367
nano	10^{-9}	0.000000001	2^{-30}	0.0000000093132

megabytes per minute (MBpm)—A measurement used to determine the amount of data being transmitted per minute on a network. Because the number of megabytes transferred per minute can be very large, it's not as commonly used as megabytes per second or megabits per second.

megacycle (MC)—Equals 1 million cycles. Usually used as 1 million cycles per second. See megahertz.

megaflops—Represents 1 million floating-point operations per second. A way to measure a computer's speed in performing floating-point calculations. See floating-point coprocessor. See floating-point notation. See floating-point operations per second.

megahertz (MHz)—Used to measure a CPU's speed, one megahertz is equivalent to 1 million cycles per second.

memory—The place a computer holds information currently being used or worked on. Programs must be loaded into memory before they can run, so the amount (or capacity) of memory determines which programs a computer can run, how many it can run at once, and how quickly data can be processed. The contents of RAM, or short-term memory, are erased when the computer is turned off. Memory also refers to the permanent, preprogrammed memory of ROM. See electrical erasable programmable read-only memory. See erasable programmable read-only memory. See random-access memory. See read-only memory.

memory address— The location of data in a computer's memory. In Windows 95 and Windows 98 the "blue screen of death" may report a memory-address error as the cause of a computer crash. These occur when data is not at the memory location Windows expects it to be or the data there is corrupted. If memory address errors frequently crash a computer, the computer may have a bad memory chip. See memory. See direct address.

memory cache—See cache.

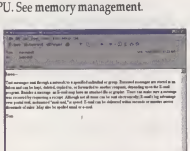
memory capacity—The amount of RAM, and, sometimes, ROM on a computer. A computer's memory capacity determines which programs it can run, how many it can run at once, and how quickly data can be processed.

memory cartridge—A RAM cartridge usually used in portable computers to store information.

memory chips—Integrated circuits that hold information. RAM is used for temporary storage of data that is currently being used or worked on; ROM is for permanent storage, including the instructions a computer reads when it is turned on. Groups of memory chips can be held on a single in-line memory module (SIMM), which is easier to install than older memory chips.

memory management—The process of monitoring the various methods used to store data in a computer's memory. Memory management programs reclaim memory spaces when they are no longer being utilized by their assigned applications. In most PCs, memory management covers the use of conventional memory, the upper memory area, the high memory area, extended memory, and expanded memory. See conventional memory. See expanded memory. See extended memory. See high-memory area. See upper memory area.

memory management unit (MMU)—The section of a CPU that controls the assignment and usage of memory within the CPU. See memory management.



message

memory manager—A program or portion of an operating system (OS) that organizes a computer's memory so it can run more efficiently. DOS 5.0 and newer versions have built-in memory managers, Himem.sys for extended memory and Emm386.exe for expanded memory. See memory management.

memory resident—See terminate-and-stay-resident program.

menu—A list of command choices offered to the user. How you select a menu option depends upon the nature of the application or operating system. Typing a number or letter or clicking a word with a mouse are two common methods. See pull-down menu.

menu

menu bar—Located just below the title bar, the menu bar lists the names of an application's pull-down menus. To open a menu listed on the menu bar in most programs and operating systems with a graphical user interface (GUI), you can click its name with your mouse or press the ALT key in conjunction with whichever letter is underlined in the menu's name. See graphical user interface.

menu-driven—A type of program in which the user selects commands from a menu. A command-driven program (such as DOS), where the user must type choices at a command line, is the opposite of a menu-driven program (such as Windows).

merge—To put two sets of data together while keeping the integrity of each intact.

merged transistor logic—See integrated injection logic.

message—A set of information electronically transferred between devices. One example is electronic mail (E-mail), which is transferred from one person to another via computer and a communications line. Messages are also transferred from an application or operating system to a user and back again.

message body—The text of an electronic mail (E-mail) message; the message body does not include the fields for recipient, carbon copy (CC:), and subject. See electronic mail.

message queue—A storage place for messages on a network. Messages line up to be transmitted and are sent out in their received order.

messaging application programming interface (MAPI)—A Microsoft Windows

program interface that allows users to send and receive electronic mail (E-mail) from within any MAPI-compliant application through the Microsoft Mail messaging system. It is possible to attach the working document to an E-mail and send it off as well. Several types of applications can utilize MAPI, including word processors, spreadsheets, and graphic applications. See **application program interface**.

metacharacter—See wildcard character.

metafile— A file that contains another file or that specifies or refers to another file. It can also mean a file used to exchange graphic files between different graphics programs or operating systems. See **computer graphics metafile**.

metalanguage—A language used to describe aspects about another language or languages. For example, one metalanguage can be used to define a programming language.

metal-oxide semiconductor (MOS)—A type of transistor easily fabricated in mass quantities, leading to its popular use in computer chips and audio amplification circuitry. MOS transistors are the part of a circuit most vulnerable to static electricity. See **transistor**.

metal-oxide semiconductor field-effect transistor (MOSFET)—A single transistor made with metal-oxide semiconductor (MOS) technology. See **metal-oxide semiconductor**. See **transistor**.

metropolitan-area network (MAN)—A network that serves an area anywhere from a few kilometers to more than 50 kilometers in size, such as a city or university. A MAN is bigger than a local-area network (LAN), which serves one building or complex, but smaller than a wide-area network (WAN), which may have worldwide coverage. A MAN links two or more LANs, but it often runs more quickly and has more access methods. See **local-area network**. See **wide-area network**.

mflops—See **megaflops**.

MFM encoding—See **modified frequency modulation encoding**.

MHz—See **megahertz**.

MICR—See **magnetic-ink character recognition**.

micro—A prefix meaning one-millionth. Also can be used informally to indicate an object is tiny.

micro-channel architecture (MCA)—The bus architecture developed by IBM for its PS/2 computers. Also called the PS/2 bus. The Micro Channel, designed for multiprocessing, functions as either a 16-bit or a 32-bit bus. The bus is an interface between the computer and its expansion cards. MCA is incompatible with the Industry Standard Architecture (ISA) bus it attempted to replace. Since many users already owned ISA expansion cards that would be useless with the new architecture, MCA was not a widely hailed development even though it enjoyed advantages over ISA. In response to MCA, IBM competitors developed the Extended ISA (EISA) standard, which was compatible with older ISA cards. See **Extended Industry Standard Architecture**. See **Industry Standard Architecture**.

microchip—See **integrated circuit**.

microcode—See **firmware**.

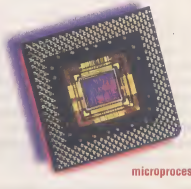
Microcom Networking Protocol (MNP)—A communications protocol developed by Microcom Inc. that is embedded into many high-speed modems. It specifies data compression and error control, which corrects unwanted changes caused by telephone line interference during data transmissions.

microcomputer—Generally refers to a PC. Technically, a microcomputer has a CPU and peripherals. It is smaller and slower than a minicomputer or a mainframe. See **personal computer**.

microfloppy disk—See **diskette**.

microkernel— A type of operating system that breaks up its functions into smaller modules. Microkernels are more efficient than standard kernels because their individual modules can be restarted or reconfigured without shutting down or restarting the computer. This style of operating system is most commonly used in variants of the Unix operating system. See **kernel**. See **Unix**.

microprcessor—The integrated circuit , known as the CPU, that controls the computer. Today's microprocessors cram more than 1 million transistors into 1 square inch of space. Microprocessors are responsible for interpreting instructions gathered from



microprocessor

input devices and transmitting the results to output devices. Though there are many types of microprocessors, the two main families used in PCs are Intel Corp.'s line, which includes the Pentium II, III and Celeron; and AMD's line, which includes the K6-2 and K6 III. The PowerPC microprocessor is used in Macintoshes and is part of a joint venture among Apple Computer, IBM Corp., and Motorola Corp.

microsecond—One millionth of a second. Sometimes used to measure how quickly data can be transmitted.

Microsoft Cluster Server (MSCS)—A feature of Windows NT 4.0 that allows NT servers to form clusters of two servers. When servers form clusters, they can be managed as a single system. To use this feature, users must have two servers connected by a network, a way for each server to access the other's data, and cluster software such as MCS. MCS also provides failure detection and the ability for one server to take over if the other goes down. Later versions of MSCS will allow clusters of more than two servers.

Microsoft disk operating system (MS-DOS)—Microsoft Corp.'s version of DOS, which shares many of the same functions as IBM's PC DOS, was first released in 1981. It is an operating system that controls input

and output operations, peripheral controls, and other processor functions. See **DOS**.

Microsoft Windows—See **Windows**.

MIDI—See **Musical Instrument Digital Interface**.

MIDI Sequencer Device—Software or hardware that converts audio into a musical instrument digital interface (MIDI) file. Sequencers record MIDI files and allow users to edit them. While a variety of programs exist that will play MIDI files, only sequencers allow users to edit and record MIDI files. See **musical instrument digital interface**.

milli—A prefix meaning one-thousandth of a unit of measurement, as in millimeter (one-thousandth of a meter).

million instructions per second (MIPS)—The approximate number of commands carried out in one second. Microprocessor power is sometimes measured in MIPS as a way of comparing chips.

millisecond—One-thousandth of a second.

MIME—See **Multipurpose Internet Mail Extensions**.

MIME encoding—See **Multipurpose Internet Mail Extensions**.

minicomputer—A mid-sized computer between microcomputers and mainframes in terms of power, size, and price. Today the term does not mean as much because modern computers fit on a desktop.

minifloppy—See **diskette**.

minimize—Reducing a window to a small button or icon, while keeping the application running inside it open. In Windows 95, 98, and NT, the minimize button is located in the upper-right corner of the application and has a short horizontal line at the bottom. When you minimize an application, it appears in the taskbar as a button, which if clicked, maximizes the application.

minimize button—See **minimize**.

minimize icon—See **minimize**.

minitower—See **tower model**.

minor key—See **ALT key**.

MIPS—See **million instructions per second**.

mirror site—A site, or directory, that contains the same directory structure as another area. Mirror sites were developed after heavy traffic slowed access to popular locations on the World Wide Web. For example, NASA's online video site has several mirrors with the same information.

MIS—See **management information system**.

MMU—See **memory management unit**.

MMX—Commonly known as an abbreviation for multimedia extensions, but according to Intel it is not an acronym. Intel's MMX technology for CPUs lets PCs take advantage of redundancies when reproducing graphics and audio, increasing performance in multimedia applications.

mnemonic—An easy-to-remember name given to a device's technical function. For example, most programming languages such as Java and BASIC use mnemonics.

MNP—See **Microcom Networking Protocol**.

mode—An operational state a program or computer must be in to perform certain tasks; the type of mode indicates which operations the computer is prepared to handle. For example, a computer operating in Protected mode is prepared to multitask, as well as allow the user to access extended memory. There are several modes for both hardware and software, including Protected mode, Real mode, and Edit mode, among others. See Edit mode. See Protected mode. See **real mode**.

Model.COM—See **Component Object Model**.

modem—Acronym for modulator/demodulator. Lets a computer transmit and receive information over telephone lines. Modems convert analog data into digital data computers can read, and convert digital data into analog data so it can be transmitted over telephone lines. Modems are the primary way home computer users connect to outside networks such as the Internet and commercial online services. Different modems are able to transmit data at different speeds, but faster modems are still able to communicate with slower modems at the highest shared speed. The slowest modems transmit information at a rate of only 300bps; the current standard found on most new computers is 56Kbps. An alternative to a standard modem is an Integrated Services Digital Network adapter. See **external modem**. See **internal modem**.

moderator—A manager of online exchanges, such as mailing lists, newsgroups, and discussion forums for major Internet servers. A moderator attempts to ensure new articles adhere to the previously selected topics.

modified frequency modulation (MFM) encoding—A common way for a disk controller to record information on disks. Data is recorded onto a bit based upon the data recorded on the preceding bit. It is slower and less efficient than run-length limited encoding, another common data encoding scheme. Compare to **run-length limited encoding**.

modifier key—A keyboard key that changes or modifies the output of another key. For example, the SHIFT key capitalizes lowercase letters.

modulate—In a communications program, the process of changing a signal prior to transmission so signals are translated into meaningful information. For example, a frequency modulator decodes signals over a telephone line into data displayed on a computer screen. Each tiny variation in the signal's depth, height, or frequency conveys a piece of information. Modems are frequently used for modulation of phone signals. See **demodulation**.

modulator—A device that converts digital signals to analog signals in a modem. See **modulate**.

modulator/demodulator—See **modem**.

module—An individual piece of hardware or software. In hardware, for example, there are dual in-line memory modules (DIMMs),

memory chips commonly used in personal computers. In software, modules are parts of a program's code that handle a specific function. Breaking code into modules simplifies maintaining that code—if there's a problem with an aspect of the program, it's easy to find that part of the code. It also makes reusing code easier. Object-oriented programming is the best example of modular programming. See **object-oriented programming**.

moiré—The distortion of an image, on-screen or on a printed copy, resulting from mixed signals or differences in resolution from the image and its display.

monitor—A video display screen and the hard shell that holds it. Also called video display terminal. In the common usage, monitor refers to devices that contain no electronic equipment other than what is essentially needed to display and adjust the characteristics of an image. Thus, a television set should not be referred to as a monitor. There are two general types of monitors: monochrome and color. Monochrome monitors use two colors—most often black and white, black and amber, or black and green—to display characters on the screen. Color monitors, which include Color/Graphics Adapter (CGA), Enhanced Graphics Adapter (EGA), VGA, and Super VGA (SVGA), display images of color. The

monitor

number of colors displayed and the quality of the image depends upon the type of monitor used. See color/graphics adapter (CGA). See **enhanced graphics adapter**. See **Super VGA**. See **video graphics array**.

monitor interface cable—The cable that carries the video signal from the computer to the monitor. See **monitor**.

monochrome—Literally, one color. So-called monochrome monitors, however, actually use two colors, one for the foreground (text and images) and one for the background. See **monochrome monitor**.

monochrome display—See **monochrome display adapter**.

monochrome display adapter (MDA)—The first text-only video display standard from IBM, MDA cards were often replaced with cards that allowed the display of graphics, such as Hercules cards. See **Hercules**.

monochrome graphics adapter—See **monochrome display adapter**.

monochrome monitor—A monitor that has one background color and one foreground color—usually white on black, black on white, green on black, or amber on black.

monospacing—Using a type font, called fixed-width, where each character is the same width. Compare to **proportional spacing**.

monospacing (example on top.)

Moore's Law—An observation by then Intel chairman Gordon Moore in 1965 that the number of transistors on a microchip (or, their computing power) doubles each year. The law has stood the test of time, though the development of new microchips later slowed slightly. The law has changed, with Moore's approval, to 18 months instead of a year.

morphing—A method of animation that seamlessly transforms one image into another. Morphing is derived from the word metamorphosis, which means a drastic change in the physical appearance or form of an object. Morphing was introduced to the public in a 1993 Michael Jackson music video, and has since become a mainstay of political ads, television commercials, and special effects for major Hollywood productions.

MOS—See **metal-oxide semiconductor**.

Mosaic—The first widely available, graphical World Wide Web (WWW) browser, Mosaic is an application that reproduces the text, graphics, and sound files from the Web into viewable computer documents. Developed by the National Center for Supercomputing Applications, Mosaic is given credit for expanding the popularity of the Web. Some of the programmers who helped develop it later went on to help write Netscape Navigator. See **World Wide Web**.

MOSFET—See **metal-oxide semiconductor field-effect transistor**.

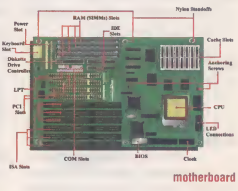
most significant bit—The left-most bit in a string of bits. See **least significant bit**.

most significant byte—The left-most byte in a string of bytes. See **least significant bit**.

most significant character (MSC)—The left-most character in a string of characters. See **least significant bit**.

most significant digit (MSD)—The far-left digit in a string of digits. See **least significant bit**.

motherboard—The printed circuit board that is the foundation of a computer. This board contains a computer's CPU, RAM chips, and expansion slots. The mother-



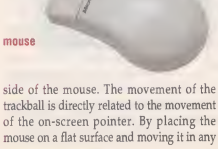
motherboard

board is where all of the computer's components meet. Also called system board or mainboard.

Motion Picture Experts Group (MPEG)—(Pronounced EM-peg.) A widely used video compression standard used by most computers that can show video, produced through either software or hardware. The major difference between MPEG and other video standards, such as QuickTime and Video for Windows, is the special components that MPEG requires for the decompression of video. MPEG achieves its high compression rate by storing only the changes between video frames, rather than each frame in its entirety. The first MPEG standard used for computers, MPEG-1, has a resolution of 352 x 240 pixels at 30 frames per second (fps). A more advanced version, MPEG-2, has a resolution of 720 x 480 pixels at 30fps. Although an MPEG-3 version was being developed for use with high-definition television (HDTV) operating up to 1,920 by 1,080 at 30 frames per second, it was dropped after it was discovered earlier MPEG versions could be fine-tuned to work with the new HDTV. Specifications for a version 4 are currently under way. MPEG-4 reportedly will be based on the QuickTime file format. The new standard would be designed to allow video for videophones, mobile multimedia, interactive multimedia databases, and sign-language captioning.

mount—To insert a diskette or tape so the computer has access to it. It also can mean to install hardware into a computer.

mouse—An input device that lets a user control an on-screen pointer in a graphical user interface (GUI). A mouse, which received its name because it slightly (very slightly) resembles a small rodent, is characterized by a trackball located on the underside of the mouse. The movement of the trackball is directly related to the movement of the on-screen pointer. By placing the mouse on a flat surface and moving it in any direction on the mousepad, the user can move the on-screen pointer in similar directions on the screen. The mouse also has one, two, or three buttons on its topside. Clicking or double-clicking a button performs an on-screen action, such as opening a file or viewing system properties. A mouse used with a Macintosh computer has one button; a typical PC mouse has two buttons, but some have three. See **mouse button**. See **trackball**.



mouse

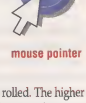
mouse button—One of two or more buttons on the top side of a mouse that let the user interface with the computer via the mouse pointer. When the user clicks the button, a signal is sent to the pointer, which selects the object that the pointer is resting on. See **mouse**. See **mouse pointer**.

mouse cursor—See **mouse pointer**.

mouse driver—A program that allows a computer to communicate with a mouse. See **device driver**. See **mouse**.

mousepad—A flat, usually rectangular pad on which a mouse is moved to give its trackball more traction. The mouse pad also protects the trackball from the dust and dirt that accumulates on a desk, which could build up on the trackball and prevent the mouse from moving accurately. See **mouse**. See **trackball**.

mouse pointer—The cursor, often shaped like an arrow, that moves when a mouse is moved. See **mouse**.



mouse pointer

mouse sensitivity—The speed at which a mouse pointer moves when a mouse's trackball is rolled. The higher the sensitivity of a mouse, the more the pointer will move in response to a trackball movement. In contrast, if the sensitivity of the mouse driver or application is increased, the cursor movement will be decreased. See **mouse**. See **trackball**.

.MOV—A QuickTime movie file. See **QuickTime**.

MP3—Short for MPEG Audio Layer 3, this format uses a sound layer of the MPEG video format to compress audio to one-twelfth its original size while still providing CD-quality sound. MP3 can compress a minute of music into one megabyte of disk space. The compression is achieved by removing sound outside the spectrum humans can hear. MP3 files have become a popular way of sharing music over the Internet. The format promises to help those musicians that want to publish their own music on the Internet, but the music industry has become concerned because the format also allows users to quickly distribute CD-quality pirate or bootleg copies of CDs. See **Motion Picture Experts Group**.

MPC—See **multimedia PC**.

MPEG—See **Motion Picture Experts Group**.

MR—See **magnetoresistive head**.

ms—See **millisecond**.

MSB—See **most significant bit**. See **most significant byte**.

MSC—See **most significant character**.

MSCS—See **Microsoft Cluster Server**.

MSD—See **most significant digit**.

MS-DOS—See **Microsoft disk operating system**.

MS-DOS prompt—See **prompt**.

MS Windows—See **Windows**.

MTBF—See **mean time between failures**.

MUD—See **multi-user dungeon**.

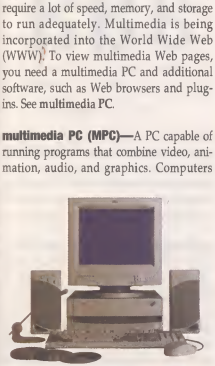
multi-color graphics array (MCGA)—A video display standard built into older IBM PS/2 computers manufactured in the late 1980s. This graphics system has less software support than the much more common VGA or Super VGA (SVGA) standards. The MCGA can imitate the color/graphic adapter (CGA), in addition to providing two other graphics modes. See **color/graphics adapter**. See **Super Video Graphics Array**. See **video graphics array**.

MultiFinder—A version of the Apple Macintosh Finder. It provides support for multitasking. See **multitasking**.

multifrequency monitor—A monitor that can accept video signals at more than one frequency. Whereas multiscanning monitors can accept signals at any frequency in a range, multifrequency monitors can only be set to a certain number. See fixed-frequency monitor. See **multiscanning monitor**.

multimedia—The combination of audio, video, animation, and graphics. Multimedia software presents information in all of these contexts; multimedia computers are able to run these types of programs. Multimedia applications are hardware-intensive; they require a lot of speed, memory, and storage to run adequately. Multimedia is being incorporated into the World Wide Web (WWW). To view multimedia Web pages, you need a multimedia PC and additional software, such as Web browsers and plug-ins. See **multimedia PC**.

multimedia PC (MPC)—A PC capable of running programs that combine video, animation, audio, and graphics. Computers



multimedia PC

with the MPC label meet the multimedia technical requirements set by the Multimedia PC Marketing Council. Computers sold today easily meet the latest MPC standards, which require a 75 MHz Pentium CPU, 8MB RAM, a quad-speed CD-ROM drive, and a 16-bit wavetable sound card. Older PCs can be upgraded to meet MPC standards, either by purchasing items separately, or in commercially available packages called multimedia upgrade kits.

multiple frequency monitor—See **multifrequency monitor**.

multiple-user system—See **multi-user system**.

multiplexer—A circuit that allows several devices to send data over a single communication line. See **communications line**.

multiplexing—To allow the simultaneous use of a single communications line by several devices. See **communications line**.

multipoint—A type of communication where many devices share a single communications line. See **communications line**.

multiprocessing—A system's ability to carry out more than one program at the same time with the use of more than one processor.

Multipurpose Internet Mail Extensions (MIME)—(Pronounced mime.) The standard format for attaching non-text files, such as graphics and spreadsheets, to text-based electronic mail (E-mail) messages.

multiscanning monitor—A monitor that has the ability to respond to any frequency within a range, as opposed to a fixed-frequency monitor that only responds to one frequency, or a multifrequency monitor, which responds to a set of frequencies. Although multiscanning monitors can display images from virtually any video display board, there are only a limited number of video standards to take advantage of a multiscanning monitor's abilities. See **fixed-frequency monitor**. See **multifrequency monitor**.

multisession—A way of recording CD-ROM discs that allows data to be added in blocks instead of recording the entire disc at once. For example, half of the disc could be written one day and the rest written a few weeks later. Some older CD-ROM drives can't read multisession discs. This type of recording is used by some CD-Recordable (CD-R) drives and all **CD-Rewriteable drives**. See **CD-Rewriteable**. See CD-recordable drive

multisession

multisync monitor—See **multiscanning monitor**.

multitasking—The process of having a computer perform multiple tasks simultaneously. During multitasking, some tasks (such as sending faxes or calculations) can be performed in the background while you work on another program. With true multitasking in a Windows environment, there is virtually no loss of performance. Compare to task switching. See cooperative multitasking. See **pre-emptive multitasking**.

multithreading—The process of having a computer run several threads inside a program at the same time.

multi-user dungeon (MUD)—(Pronounced mud.) Text- or graphics-

multi-user dungeon

enhanced virtual online environments used for everything from cooperative research to idle chatting and role-playing. For example, the "holodeck" on the television show "Star Trek: The Next Generation" is a fictional form of a MUD. See **virtual reality**.

multi-user system—Traditionally a centralized computer system that allows access to more than one person at a time, such as a mainframe. It is also used to describe software several people can access at once, for example, across a network.

MUMPS—See Massachusetts Utility MultiProgramming System (MUMPS).

Musical Instrument Digital Interface (MIDI)—(Pronounced middee.) Digitally representing and transmitting sounds that electronic devices, such as keyboards and sound cards, universally understand. It

provides a protocol for transforming music into data and vice versa.

mux—See multiplexer.

mylar ribbon—See carbon ribbon.

N

n—See nano- (n).

NAK—See negative acknowledgment.

name server protocol—Used in Transmission Control Protocol/Internet Protocol (TCP/IP) connections. The name server answers requests from users to help them get to the computer or information they want. The system translates the name of a site on the Internet into an Internet Protocol (IP) address that the connected computers can understand.

nano- (n)—A prefix designating one-billionth of a unit of measurement.

nanometer—A unit of length representing one-billionth of a meter.

nanosecond (ns)—A unit of time representing one-billionth of a second.

nanotechnology—A science that showcases the process of building in terms of an object's smallest elements, such as the molecular or atomic makeup of an item.

narrowband transmission—Describes a transmission channel in communications that has a slow data transfer rate, particularly any channel with a maximum throughput of 2400bps.

National Information Infrastructure (NII)—The name of the national communications system of the United States. The NII includes all current and future communications networks regardless of transmission method, such as cellular, cable, and bandwidth; all communications devices, such as computers, radios, telephones, and televisions; and all forms of transmitted information, including text, graphics, video, and audio. The principles guiding the development of the NII include promotion of private sector investment and extension of the universal service concept, which ensures the widespread availability of information resources, promotes technological development, and ensures information security on the NII.

National Television System Committee (NTSC)—A U.S. committee responsible for creating technological television and video standards, including refresh rate and color capabilities. The NTSC also creates the format for transmitting television signals in the United States. Because most computers use a different video standard than television, these standards do not apply to computer monitors or video capabilities.

native code—See native language.

native compiler—A computer application that converts one language (usually a high-end programming language such as BASIC, COBOL, or C++) into binary machine code that a computer can understand. Programs must be compiled (or in the case of assembly language "assembled,") to function. Compilers are included as a matter of course with programming development kits.

native file format—The way an application fundamentally arranges and presents data. One example of a native file format is the way Microsoft Word inherently arranges and presents text in a file with a .DOC extension. The native file format may be peculiar to one program, or it may be universally accepted.

native language—The most basic computer language used by the computer's processor to communicate with the rest of the system when no other language has been introduced to the computer. In most cases, the native language is the binary code inherent to the processor before the operating system (OS) has been introduced.

natural language—A programming language that uses the grammar, vocabulary, and syntax of human language. See **programming language**.

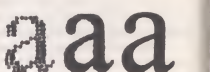
natural language processing—In artificial intelligence (AI), the grammatical and syntactical analysis of human language by a computer in order to derive meaning from the language. See **artificial intelligence**.

NC—See **network computer**.

NDR—See **nondestructive readout**.

NDRO—See **nondestructive readout**.

near-letter quality—A printing mode on dot matrix computers indicating the printed letters are clearer and less jagged or pixelated than typical dot matrix printout. This



near-letter quality

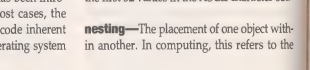
mode still falls far short of inkjet or laser printer quality. Compare to **draft mode**.

near-typeset quality—Text produced by a laser printer that nearly matches the quality of typeset print.

negation—The conversion of a binary digit, or bit, into its opposite. A 1 converted into a 0, or the string 1001001 converted to 0110110, are both examples of negation.

negative acknowledgment (NAK)—A signal sent among computers in a network or between components in a single computer system indicating either a data transmission has been erroneously received or data has been corrupted during transmission. The negative acknowledgment signal is part of the first 32 values in the ASCII character set.

nesting—The placement of one object within another. In computing, this refers to the



nesting

placement of a graphic in a word processing document or a text document within a database. A set of instructions also can be nested in another set of instructions or within a document activated when selected. Programmers also can nest programming loops within other programming loops.

'net—Short for network, a system of conjoined computers. This term also can be used without the apostrophe. See **network**.

'Net—Short for Internet, a set of loosely connected networks that use the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol. This term also can be used without the apostrophe. See **Internet**. See **Transmission Control Protocol/Internet Protocol**.

NetBEUI—See NetBIOS extended user interface.

netBIOS—See Network Basic Input/Output System.

NetBIOS extended user interface (NetBEUI)—The enhanced network protocol now used by all Microsoft networking systems and local-area network (LAN) server-based systems to support communication. See **Network Basic/Input Output System**.

'Netiquette—Slang for the unwritten rules of Internet courtesy.

'Netizen—Slang for a frequent Internet user.

NetPC—The Microsoft-supported, scaled-down computer that relies on centralized resources to run. Each time the NetPC boots up, it checks the server to see if it has the most up-to-date system setup. If not, it downloads the correct files and configuration. Programs can't be installed on the computers except from the central server, since NetPCs usually lack diskette drives and CD-ROM drives. Like network computers, NetPCs can be cost-effective in initial cost, maintenance, and upgrading, for companies that have a large number of employees doing tasks that don't require much computing power, such as data entry, word processing, or other basic office tasks. Net PCs allow administrators to make changes to the operating system on all the computers in an office or company without going to each computer and manually changing the setup or installing software. Compare to network computer (NC).

NetWare—A network operating system (OS), produced by Novell, that allows for multitasking. NetWare can be used on desktop OS, such as Windows, DOS, OS/2, and Unix.

network—A set of conjoined computers that can share storage devices, peripherals, and applications. Networks may be connected directly by cable connection, or indirectly by telephone lines or satellites, and can be part of a small-office system or a global web of numerous other networks. See **local-area network**. See **wide-area network**.

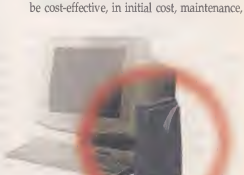
network adapter—See network interface card.

network administrator—An individual responsible for the maintenance and operation of a network computer system.

network architecture—The basic, unifying structure of a communications system. Network architecture includes the hardware, software, access methods, interfaces, and protocols used to tie a group of interconnected computers together. It is designed to ensure quality communication and effective, reliable data transfer. IBM's System Network Architecture (SNA) and the ISO Open Systems Interconnection (ISO/OSI) are two of the most popular designs in use. Both the SNA and the OSI are multi-layer network designs, with each layer created to handle a specific aspect of the communications system. See **Open Systems Interconnection**. See **Systems Network Architecture**.

Network Basic Input/Output System (NetBIOS)—A connection point at which information is transmitted between software applications and IBM operating systems (OS/2, DOS, and AIX) on a network.

network computer (NC)—A scaled-down computer, developed by Sun Microsystems and Oracle, that relies on centralized resources to run, similar to a mainframe-terminal setup. Network computers have just enough hardware to run a Web browser and Java applications and applets. System software consists of a browser and Java Virtual Machine, on which Java applications rely. There is no diskette drive or CD-ROM, but a printer can be hooked up through a parallel port. All programs are downloaded from a central server and all files are stored on that server. Like NetPCs, network computers can be cost-effective, in initial cost, maintenance,



network computer

and upgrading, for companies that have a large number of employees doing tasks that don't require much computing power, such as data input, word processing, or other basic office tasks. The developers of the NC hope to use applets to perform most of the tasks personal computers perform, including word processing and checking E-mail messages. Compare to **NetPC**. Compare to **server**.

network control program—A software application in a group of interconnected computers that undertakes most of the communication functions. The control program runs on a device independent of the mainframe processor, thereby freeing primary system resources.

network database—A set of information files in a group of interconnected computers from which any computer part of the group can access data. Also can refer to a database on a network that holds addresses of all members of the network.

network device driver—The software, usually distributed by the manufacturer, that allows a specific network card to communicate with the rest of the computer system and the network.

network directory—A list of data files in a group of interconnected computers that is available for use but not located on the computer from which the information is being accessed.

network drive—A disk drive whose data is available to all other computers in a group of interconnected computers. Access to network drives can be controlled by passwords and other multiple security devices. These drives can store records and files for users who need access to them.

Network File System (NFS)—A client/server file system used to share files across a network. Developed by Sun Microsystems and used primarily on Unix workstations. Client software must be installed on all client computers and server software must be installed on the server. Users can then mount the entire file system on the server or only specific directories and can read from or write to the server. NFS only works on networks that use the Transmission Control Protocol/Internet Protocol (TCP/IP). Compare to **AFS**. See **Transmission Control Protocol/ Internet Protocol**.

network interface card (NIC)—(Pronounced nick.) A printed circuit board containing the necessary hardware used to connect a computer to a network. See **network**.

network model—A system structure in a group of interconnected computers that allows each data file to be accessed from more than one location.

network operating system (NOS)—In a group of interconnected computers, the foundation software that allows computers to work together and communicate. It directs the communication functions, security protection, and data and peripheral sharing within the group. Examples of NOSes include Windows NT, Novell NetWare, and LANtastic.

network printer—A printer accessible by all computers connected to the network. See **network**.

network server—The computer that controls access and offers resources to other computers in a group of interconnected computers. A server usually contains a network drive and a network directory.

network structure—A method of organizing data records for a network model in a group of interconnected computers. See **network model**.

network data integrity—In a database management system, the level of correctness and consistency of data stored in a collection of files in a database, especially after one file has been affected by a change.

neural network—A method of simulating artificial intelligence (AI) by combining a number of parallel processing units that can each accept only a few input signals. When these few signals are slightly manipulated by increasing and decreasing the strength of the signal, the computer recognizes the irregularities and, after a certain manipulation has occurred a number of times, the computer "learns" to adjust its output to conform to the slight difference in the input signal. A neural network is patterned after the way the human brain receives and processes information. See **artificial intelligence**.

newsgroup—On the Internet, a virtual area reserved for the discussion of a certain topic. A newsgroup may be controlled, or moderated, by an individual who monitors all messages transmitted to the area. The moderator filters out irrelevant and redundant messages, although plenty of these messages still make it into the newsgroups. Some newsgroups offer mailing lists that send, via electronic mail (E-mail), all the messages posted to the newsgroup each day to every newsgroup member. There are tens of thousands of newsgroups on the Internet, and new ones form every day. See **news server**.

news server—A remote computer that controls access to a newsgroup in a group of interconnected computers. Individuals who are interested in posting a message to a newsgroup or retrieving a message from a newsgroup first must establish a connection with the news server. See **newsgroup**.

NFS—See **Network File System**.

nibble—Four bits or half a byte.

NIC—See **network interface card**.

NiCad—A trademarked name for a nickel-cadmium battery owned by SAFT America Inc. See **nickel-cadmium battery**.

nickel-cadmium battery—A rechargeable battery, primarily made of nickel and cadmium, that once was common in portable computers. A primary problem with the batteries was they needed to be completely drained before they could be recharged. A nickel-cadmium battery would assume it was empty of all power each time it was recharged. When the battery reached its previous low level, it would go dead, assuming no power was left. This was often referred to as "memory loss." Nickel-cadmium batteries are rarely found in new portable computers; nickel-metal hydride (NiMH) and lithium-ion (Li-Ion) batteries have become more popular. Sometimes referred to by the trademarked name NiCad owned by SAFT America Inc. Compare to **lithium-ion battery**. Compare to **nickel-metal hydride battery**.

nickel-metal hydride (NiMH) battery—A rechargeable battery used primarily in portable computers. These batteries do not suffer from the "memory loss" problem of nickel-cadmium batteries and can store more power. Although the NiMH battery is now more common than the nickel-cadmium battery, it is beginning to lose its popularity to the lithium-ion (Li-Ion) battery. Compare to **lithium-ion battery**. Compare to **nickel-cadmium battery**.

NII—See **National Information Infrastructure**.

nil pointer—See **null pointer**.

NiMH—See **nickel-metal hydride battery**.

NLQ—See **near-letter quality**.

NMI—See **nonmaskable interrupt**.

node—Any device that can communicate with other computers in a group of interconnected computers. Usually, a node refers specifically to a computer system or terminal that is part of a network.

node address—A name or number that identifies a specific computer or terminal in a group of interconnected computers.

node encryption—A security measure in a group of interconnected computers that transcribes the data into an indecipherable code as it passes through each computer, often described as a node. At each computer, the information is translated into its original form and then encrypted for the brief journey to the next computer. See **node**.

noise—Any disturbance that interferes with data transmission and corrupts the quality of the signal.

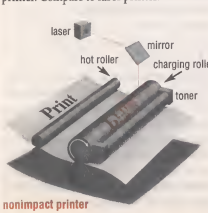
nonconductor—Any material that transmits electrical currents poorly.

noncontiguous data structure—A method of storing data in which the information is not stored in contiguous, or adjoining, sectors of memory.

nondestructive readout (NDR, NDRO)—A function that allows for the permanent or temporary storage of processed data. For example, a CPU does not destroy data after it has been read.

nonexecutable statement—A programming command that cannot be performed, by the computer system. A remark (REM) statement in a system file is one example of a nonexecutable statement. See **comment**.

nonimpact printer—Any type of printer that leaves an imprint without physically touching the page. Laser and inkjet printers are nonimpact printers. Laser printers trace the image of the letter onto a photosensitive drum. The traced image electrostatically attracts the toner to the image. When a page passes over the drum, a blast of heat "melts" the ink to the page. Inkjet printers spray the ink onto the page. Compare to **inkjet printer**. Compare to **laser printer**.



nonimpact printer

noninterlaced—A way an image is produced and refreshed on a computer screen. In a typical computer monitor, an image is produced by a series of horizontal lines that run from the top of the screen to the bottom. This is known as a raster display. An image is produced or refreshed in a noninterlaced manner when every pixel of every line is updated during every cycle; conversely, an image is produced or refreshed in an interlaced manner when every odd-numbered line is updated during the odd-numbered cycles, and every even-numbered line is updated on the even-numbered cycles. However, this interlaced every-other-line method can cause the screen image to flicker, making it hard on a user's eyes. Therefore, a noninterlaced monitor is preferable.

nonmaskable interrupt (NMI)—A rarely used request for attention between vital hardware devices, such as a hard drive, CPU, or modem, within a computer system. A nonmaskable interrupt overrides all software and nonvital hardware, such as a keyboard or mouse. A nonmaskable interrupt is used only in emergency situations.

non-pre-emptive multitasking—A type of multitasking in which the computer is not allowed to interrupt, or pre-empt, a currently operating function until it has been completed. The Windows operating system uses non-pre-emptive multitasking. Non-pre-emptive multitasking allows some programs to dominate the use of the CPU because they cannot be interrupted.

nonprinting codes—Special command instructions sent with printable data on to the printer. Nonprinting codes regulate the printing format, but are not printed themselves.

nonreturn to zero (NRZ)—In communications, a method of transmitting data in digital binary form whereby each positively or negatively charged data bit is separated from its predecessor and successor by a cushion of time rather than a neutral charge.

nonvolatile memory—An area of data storage in the memory where data is not lost when the power is turned off. Nonvolatile memory areas include ROM and flash memory.

non-Windows application—A DOS application not designed for operation in a Windows operating system. Non-Windows applications will operate in Windows, but will run less efficiently and slower than in DOS.

NO-OP—See **no-operation instruction**.

no-operation instruction—(NO-OP, pronounced no-opp or nop.) A programming command that instructs a computer to run one or two processing cycles without performing any functions. Generally used for internal computing purposes, such as to synchronize the timing for a series of events to occur or to cancel a command. Also called do-nothing instruction.

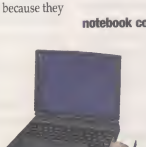
NOP—See **no-operation instruction**.

no parity—In communications, the lack of all-parity checking. There is no parity bit added to the byte. See **parity**.

NOS—See **network operating system**.

notator—A software application that converts music entered into a computer using a MIDI device, such as a synthesizer, into traditional musical notation.

notebook computer—A PC designed to be easily portable and run by batteries rather than AC current if needed. Although some models are thinner, notebook computers are about 2 to 4 inches thick, and roughly the width and height of a typical writing tablet or notebook, 8.5 inches by 11 inches. See **laptop computer**. See **portable computer**.


notebook computer

Novell DOS—See **DR-DOS**.

NRZ—See **nonreturn to zero**.

ns—See **nanosecond**.

NT file system (NTFS)—A file organizational system by which data is stored and

accessed in a Windows NT operating system. NTFS offers better methods of data protection and file recovery than a file-allocation table (FAT), the file system of DOS and Windows 3.x. It also supports long file names. See **file-allocation table**.

NTFS—See **NT file system**.

NTSC—See **National Television System Committee**.

NUL—See **null character**.

null—A lack of value.

null character—A programming code representing a character with no value designed to create time or space. For example, in teletype machines, null characters were used to allow time for the type head to return to the beginning of a line after it had reached the end of the previous line.

null cycle—The absolute minimum length of time required to completely execute a program without introducing new data or extraneous processing.

null modem—Describes the absence of a modem. For example, two computers joined directly by a cable is a null modem setup because neither requires a modem.

null-modem cable—The cable used to directly connect two computers without using a modem. The null-modem cable crosses the sending and receiving wires so the wire used for sending data from one computer is the same wire used to receive data in the other computer. Also called an RS-232 cable.

null pointer—A command variable that directs a program or operating system to an empty location in memory. A null pointer is most often used to denote the end of a memory search or processing event. See **pointer**.

null-terminated string—See **ASCIIZ string**.

numeric—A numbering system, such as the base-10 (consisting of 10 digits from 0 to 9) used throughout most of North America and Europe. A numeric system also is one way computers can store data. Compare to **alphanumeric**. Compare to **logical**.

numeric coprocessor—An ancillary processor that operates using a floating-point numbering system (a method of storing numeric calculations where the decimal point is not in a fixed location), thus expediting number-related processing, such as mathematical calculations and graphics functions. Most early-model computers, such as the 8088/86, 286, 386, and most 486 computers, have numeric coprocessors in addition to the primary system processor. See **floating-point coprocessor**. See **math coprocessor**.

numeric keypad—The 17-key keypad usually found on the far right side of a typical IBM 101/2-key keyboard. In addition to the numerical 0 to 9 keys, a numeric keypad also includes the mathematical signs for addition, subtraction, multiplication, division, a decimal point, ENTER key, and a NUM LOCK key that engages the numeric keypad for use. When the NUM LOCK key is disengaged, the Numeric keypad also can be used for cursor movement.

numeric lock key (NUM LOCK)—A key located on the numeric keypad that alters the function of 11 keys. When the numeric lock key is engaged, usually indicated by a small light on the keyboard, the number functions on the keys (0 - 9 and the decimal point) may be used; when the numeric lock key is disengaged, the cursor movement functions programmed on 10 of the keys may be used. The function of the remaining six keys (/, —, -, +, NUM LOCK, and ENTER) remains the same. See **numeric keypad**.

numeric overflow—See **overflow error**.

numeric processor extension—See **numeric coprocessor**.

NUMLOCK—See **numeric lock key**.

NUM LOCK key—See **numeric lock key**.

nybble—See **nibble**.

O

OA—See **office automation**.

object—A term used in programming to denote a reusable section of code. Object-oriented programming methods use objects as the basic building blocks of programs. Objects are generally standardized so they can be used in many different types of programs without having to be rewritten each time. In graphics, the term is used to describe a distinct element, such as a block.

object code—An intermediary step between a program's source code and machine code. Most applications are written in a source code language, such as C or BASIC. However, computers only understand machine code, the fundamental instructions that are recognized by the CPU. A compiler program is used to turn source code into object code, which is then translated into machine code. Object code is usually quite similar to machine code, and may be identical.

object computer—The computer on the receiving end of a communications attempt such as a fax or modem transmission.

object file—A file containing object code. See **object code**. See **object module**.

object linking and embedding (OLE)—(pronounced oh-lay) A method of sharing information between applications within an operating system. Objects can be most any type of data, such as a graphic or a text document. These objects can be linked or embedded in other documents, known as OLE containers. An embedded object is actually copied into the container document. Changes to the embedded object are saved in the embedded copy, but not in the original object. With linked objects, only a shortcut to the original object is placed in the document. Changes to the linked object will be saved to the original object. For example, a user might save a spreadsheet into a word processing document using OLE. If we want to keep the original spreadsheet as it is while making changes to the spreadsheet in the document, we would use embedding. However, if we wanted changes to the spreadsheet in the document to automatically show up in the original spreadsheet, we would use linking.

object linking and embedding (OLE) container—The document into which OLE

objects are inserted. For example, a Microsoft Word document could be a container for an Excel chart. This can also apply to programs. If you're using Microsoft Word, for example, and some of Microsoft Excel's functions appear in the toolbar after inserting an Excel spreadsheet, Word is a container program for Excel. See **object linking and embedding**.

object module—The version of a source code file that has been translated into object code by a compiler. Often object modules are linked together before they are executed. See **compiler**. See **object code**. See **source code**.

object oriented—A phrase used to describe languages and systems that make use of objects, or distinct pieces of data. Object-oriented programming features reusable, somewhat standardized code pieces linked together to create new applications.

object-oriented graphics—Graphics based on elements such as lines, arcs, and other shapes. Object-oriented graphics are created using a mathematical set of instructions. Compare to **bit-mapped graphics**. See **vector graphics**.

object-oriented interface—A user interface in which symbols identify individual system parts and a mouse or other input device is used for navigation. For example, in an object-oriented interface, a piece of paper may represent a file, and a folder may represent a directory of files, as is the case with Windows.

object-oriented programming (OOP)—Programming in which data structures are combined with the operations that can be applied to create objects. This enables programmers to create new objects based on existing ones; as a result each program is a collection of these objects. This, in turn, makes modifying a program easier.

object-oriented programming language (OOPL)—A programming language in which program elements are designed as objects rather than procedures. The modules are independent enough that you can copy them from one program into another, adding new features if necessary. C++ is an example of an object-oriented programming language.

oblique—A method for altering a font to make it appear italic, if a program doesn't contain an italic version of it. See **italic**.

obliquing angle—An angle that indicates how far a letter is slanted. See **oblique**.

OCR—See **optical character recognition**.

octal—The base 8 number system, which uses the digits 0 through 7. You convert binary numbers into octal by dividing them into

Decimal	Binary	Octal
00	00000	00
01	00001	01
02	00010	02
03	00011	03
04	00100	04
05	00101	05
06	00110	06
07	00111	07
08	01000	10
09	01001	11
10	01010	12
11	01011	13
12	01100	14
13	01101	15
14	01110	16
15	01111	17
16	10000	20

octal

groups of three bits, because three is one three-digit binary combination for each octal number.

octet—A set of eight. Specifically, in computing, an octal is a byte, consisting of eight bits. See **byte**.

odd header—A header printed only on the odd-numbered pages of a document.

odd parity—See **parity**.

OEM—See **original equipment manufacturer**.

off-hook—The condition of a telephone line when the dial tone is present. A line must be taken off-hook before a call can be placed. For example, when you place a telephone call, you must pick up the receiver and get a dial tone before dialing. Thus, a modem must take the line off-hook so no calls come in and it can begin a call transmission. With Dial-Up Networking, the user can require that a dial tone be present before the connecting call is made. Compare to **on-hook**.

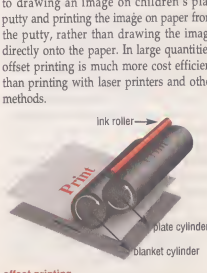
office automation (OA)—Incorporates the use of all high-tech office equipment developed in recent years. This equipment, from computers to electric pencil sharpeners, was designed to make the work environment more efficient.

offline—Broken contact between a computer and its connected devices. A device is offline, for example, when it is disconnected or when it is turned off, although a device does not need to be disconnected or turned off to be offline. The term also can be used to describe a computer or peripheral device unavailable or not ready for use by other systems. Compare to **online**.

off-line storage—Storage not currently accessible to the computer, such as files on a diskette that are not in the diskette drive.

offset—A number indicating how far from a starting point an item is located, usually in bytes. For example, an offset might tell a processor how many bytes into a segment of memory it will find a specific piece of data. This is the computing equivalent of giving directions to a house by saying it is the second one from the corner; it gives a reference point and counts from that point to the desired item.

offset printing—A method of printing by pressing paper against ink-coated, rubber cylinders. Rather than using the old printing method of direct printing, the offset printing press prints the image from printing plates to a rubber cylinder, which then prints the image onto the paper. This can be compared to drawing an image on children's play putty and printing the image on paper from the putty, rather than drawing the image directly onto the paper. In large quantities, offset printing is much more cost efficient than printing with laser printers and other methods.



offset printing

off-the-shelf—Prepackaged software or hardware. Compare to **custom software**.

ohm—A unit of resistance. A resistance level of 1 ohm means one ampere of electric current will pass through the circuit when a voltage of 1 volt is applied. The measurement is named for George Simon Ohm, a German physicist who lived from 1787 to 1854.

OLE—See **object linking and embedding**.

on-board—Located on a circuit board; sometimes meaning specifically located on the motherboard. For example, memory chips on the motherboard are referred to as on-board memory.

on-board modem—A modem on an expansion board. See **on-board**.

one-pass compiler—A compiler that can produce object code by reading through the source code only one time. Some programming languages have a syntax such that there are no one-pass compilers for them. See **object code**.

on-hook—The telephone line condition in which a call can be received, and in which there is no dial tone. For example, when your phone is hung up, with the handset in the cradle, the phone is on-hook and ready to receive calls. When a modem is through placing a call transmission, it must again place the line on-hook so there is no dial tone and it can receive incoming calls. Compare to **off-hook**.

online—A state in which the computer can interact with the device or program. Online also is used to mean interacting with the Internet or commercial online services. For example, you can say you are going online to check your electronic mail (E-mail) or to join a newsgroup. Compare to **offline**.

online help—Help available from an operating system (OS) program at the request of the user.

online service—A commercial service that provides access to such online features as electronic mail (E-mail), news services, and the World Wide Web (WWW) for a monthly fee. Examples of online services include America Online (AOL) and CompuServe.

online state—Being connected. When a modem is transmitting or receiving information it is considered to be in an online state.

OOP—See **object-oriented programming**.

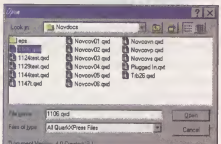
OOPL—See **object-oriented programming language**.

opaque—Not transparent. Also, hardware or software that performs only limited processing, passing along the data it has not processed.

op code—See **operation code**.

OPC drum— See **optical photoconductor drum**.

open—Accessible. In terms of computing, it can mean an open file or program is one



open

that currently can be used. Open can also mean an open shop or an open architecture, which is available to the public or to a specified group. See **open architecture**. See **open file**. See **open shop**.

open architecture—A device, such as a computer, about which the manufacturer releases specifications so others can then develop compatible products. Compare to **closed architecture**.

Open Database Connectivity (ODBC)—A standard for transferring data between two databases. The standard is especially helpful for transferring data between two databases written with two programs, such as dBASE and FoxPro or Microsoft Excel and Access. Both programs must support ODBC for the transfer to work, however. ODBC works by putting a driver between the programs that access databases and the databases themselves. When one program wants to access a database created by another program, it accesses the driver for that database. The driver retrieves the data and passes it back to the first program. See **driver**.

OpenDoc—A standard that lets multiple programs work on a single document. Similar to Microsoft Corp.'s object linking and embedding (OLE), several companies, including Apple Computers, IBM, and Lotus Development Corp., developed this standard.

open file—A file that is ready to be worked with. For example, a word processing file must be opened before text can be added or deleted.

open shop—A place where average users can work on and program computers.

Open Software Foundation (OSF)—Operating system (OS) based on Unix. The group was founded in 1988 by Apollo, Bull, Digital Equipment Corp., Hewlett-Packard, IBM, Nixdorf, and Siemens.

open source—Source code that is freely available to programmers for use in developing new software. The source is usually in the form of a standard, such as a sound format like MP3. It can also refer to an entire program (such as Netscape Communicator) or a whole operating system, such as Linux. Proponents of open source argue that by letting as many developers as possible work on a program, the software evolves. Developers will fix bugs, add new features, and adapt it for new uses or operating systems.

open system—In communications, a network designed to incorporate devices from any manufacturer, as long as theycan use the same communications protocols and facilities. Alternately, when applied to specific hardware or software, an open system is one that accepts add-ons from third-party suppliers.

open system interconnection (OSI)—A network model in which peer-to-peer

communications are divided into seven layers. Each layer performs a specific task or tasks, and builds upon the preceding layer until the communication is complete. Here are the purposes of the seven layers: 1)Physical functions (electrical, mechanical, and timing) 2)Data link connections 3)Route information through the network 4)Transfer information between endpoints on the network 5)Manage a session between two applications 6)Presentation (data formatting and display) 7)Application/user interaction

operand—The focus of an operation. In mathematics, the operands are numbers or variables, such as 2 or X. In computing instructions, operands are where data is stored, such as Track 1, Sector 7. Also, in programming languages, the part of an instruction that is needed for the instruction to be carried out.

operating environment—The environment in which programs are run. This is different from an operating system (OS), which is itself a program. For example, Windows 3.1 is an operating environment, and runs under the Microsoft DOS (MS-DOS) OS, while Windows 95 is its own OS, and does not require DOS. See **operating system**.

operating system (OS)—Software that controls a computer and its peripherals. Early OSes, such as DOS and Unix, left a great deal of the operation to the user, but later OSes, such as OS/2 and Windows 95, handle many of a computer's basic functions.

operation code (op code)—The part of a machine language instruction that tells a computer what to do.

operations research—Using scientific techniques to study successful endeavors such as management and government in an attempt to understand what makes them work well.

operator—A symbol that denotes an action to take place, such as a "+" to mean addition. Boolean operators (AND, OR, and NOT) are used to verify or disprove truth. There also are concatenation operators, which join elements together. For example, the symbol "&" often is used as a concatenation operator to connect text or phrases, such as in a database search. See **Boolean**. See **concatenate**.

operator associativity—The order of precedence of operators in an expression. Normally, associativity is left-to-right. Associativity will affect the outcome of the expression. For example, in the expression 9-6+2, where addition and subtraction have equal precedence, with left-to-right associativity, you would first subtract 6 from 9, with a sum of 3, and then add 2, for a final answer of 5. If associativity were right-to-left, you would first add 6 and 2, to get a sum of 8, and then subtract that answer from 9, to get a sum of 1 as a final answer.

operator precedence—Which operator comes first. For example, multiplication generally has a higher precedence than addition. This means that in the expression 9-3x2, you would multiply 3 by 2 and then subtract the result from 9, instead of working the problem from left to right. See **operator**.

optical character recognition (OCR)—The process in which the images of letters, entered into a computer with a scanner, are translated into characters that are worked with in the computer as text, not as an image. OCR is far from perfect, but it is a fast method for digitizing typed pages of text. Some computer fax applications also use OCR to transform incoming faxes from graphics files to word processing documents.

optical communications—Transmitting and receiving voice, data, pictures, or sound using light. This technology includes optical fibers and lasers.

optical disc—See **compact disc**.

optical fiber—A glass or plastic wire used to carry signals in the form of light. Due to the speed, capacity, and clarity of these signals, communications companies are increasingly replacing traditional cables, such as copper, with optical fibers.

optical mouse—A mouse that uses light-emitting diodes (LEDs), devices that emit light when a current is passed through them, and a special mousepad to detect motion, instead of the traditional trackball method. These mice can be somewhat more accurate because unlike the mechanical mouse, they do not contain mechanical moving parts that can wear out and collect dirt. See **mechanical mouse**. See **optomechanical mouse**.

optical photoconductor drum (OPC drum)—a key component of laser printers. The OPC drum is a cylinder coated with a substance whose magnetic properties change in the presence of light. The drum is magnetically charged and the laser changes the charge on the parts of the drum it passes over. Those areas will pick up toner and apply it to the page. See **laser printer**.

optical reader—A device, usually part of a scanner, that "reads" typed or printed words or symbols from an outside source as an image and then renders it into digital information understandable to the computer. See **optical character recognition**.

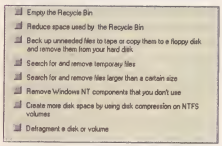
optical recognition—See **optical character recognition**.

optical resolution—The resolution at which a video device such as a scanner or camera can capture an image, expressed in dots per inch (dpi). Not to be confused with interpolated resolution, which is the resolution created by software enhancement. Interpolated resolution is generally much higher than the optical resolution, so for example, a scanner with 300dpi optical resolution could have an interpolated resolution of 4800dpi. But, most of the increase comes from the software guessing what color pixel should go between two known pixels. Depending on what's being scanned, this can either help or hurt the quality of the scanned image. The optical resolution is therefore the more important figure when buying a scanner or camera.

optical scanner—An input device that allows a user to take an image or text and render it as digital image. This image then can be converted into a graphics file or text-based file using optical character recognition (OCR) software. After such text has been translated using OCR software, it can be edited, just like text typed into the computer. Material scanned into the computer can be faxed, sent by electronic mail (E-mail), printed, and edited. There are three major categories of scanners: flatbed, sheetfed, and handheld. Flatbed scanners look like photocopiers, with a glass scanning surface on

which a document is placed. In a sheetfed scanner, the hard copy is inserted into a mechanism which guides it through the scanner. Handheld scanners require the user to move the scanner across the page, and usually only scan areas a few inches wide. They do, however, often include stitching software that will join two halves of a page scanned in this manner.

optimize—To improve performance. In computing, there are many ways to optimize the performance of your system. For example, you can optimize a hard drive by running a defragmentation program.


Enjoy the Recycle Bin
Reduce space used by the Recycle Bin
Back up unneeded files to tape or copy them to a floppy disk and remove them from your hard disk
Search for and remove temporary files
Search for and remove files larger than a certain size
Remove Windows NT components that you don't use
Create more disk space by using disk compression on NTFS volumes
Defragment a disk or volume
optimize

option—See **switch**.

optoelectronics—The combined fields of study dealing with light and electricity. A branch of electronics that studies the properties and behavior of light. This field deals with devices that generate, sense, transmit, and modulate light.

One line of a paragraph separated from the rest of the paragraph. This occurs when the first line of a paragraph is the last line of a column or a page. Orphans are aesthetically displeasing for readers, and therefore should be avoided. Compare to widow.
One line of a paragraph separated

from the rest of the paragraph. This occurs when the first line of a paragraph is the last line of a column or a page. Orphans are aesthetically displeasing for readers, and therefore should be avoided. Compare to widow.
One line of a paragraph separated from the rest of the paragra
orphan

optomechanical mouse—A hybrid mouse with attributes of both optical and mechanical mice. Movement of the mouse results in internal changes in light from light-emitting diodes (LEDs), which registers as movement. The optical characteristics of the mouse mean it's less likely to have the failures associated with the mechanical mouse. And the mechanical characteristics free the user from the pad necessary for the use of an optical mouse. Compare to **mechanical mouse**. Compare to **optical mouse**.

orange book—A set of specifications for the CD-Recordable (CD-R) format. See **CD-recordable drive**.

ordinal number—A sequential number, such as "30th".

orientation—See **landscape mode**. See **portrait mode**.

origin—The point in a coordinate system where the axes meet. The coordinate value of the origin point is (0, 0, 0).

original equipment manufacturer (OEM)—A company that produces fully manufactured computers and adds hardware, software, and its name to a product. The OEM then sells the system as its own.

OR operator—A Boolean operator that adds two values together. If either of the values being combined is a one (or True), the result of the combination is the value 1 (or True). See **Boolean**.

orphan—One line of a paragraph separated from the rest of the paragraph. This occurs when the first line of a paragraph is the last line of a column or a page. Orphans are aesthetically displeasing for readers, and therefore should be avoided. Compare to widow.

orphan file—A file whose corresponding application has been deleted or removed. These files can be documents, such as Word files, or resource files, such as dynamic link libraries (DLLs). Orphan files are nuisances because they waste hard drive space. They can generally be deleted, but users should be sure they are really deleting an orphan file, not merely a file they don't recognize. The most difficult orphans to find can be DLL files, which are dumped into the Windows directory when a program is installed. When a program is uninstalled, DLLs, which can be quite large, are often left in the WINDOWS directory. There are applications that will look for and delete orphan files, including unused DLLs. See **dynamic-link library**.

OS—See **operating system**.

OS/2—An operating system (OS) originally developed jointly by Microsoft and IBM to run on PC-compatible machines. The first Operating System/2 was a 16-bit system meant for Intel's 286-level microprocessors. In 1992 IBM released a new 32-bit version for 386 processors. The next version, OS/2 Warp, arrived in 1994. Microsoft intended to release a 3.0 version of OS/2, but this product eventually became Windows NT when the collaboration between IBM and Microsoft came apart. OS/2 features a graphical interface and capabilities similar in many ways to Windows 95. Like Windows, OS/2 supports multitasking, the ability to run multiple programs simultaneously. Although some users consider OS/2 superior to Windows, it never caught on in the same way as Microsoft's competing product. Compared to the large library of software built to run in Windows, OS/2 applications are few. Today OS/2 is used primarily by some IBM corporate customers.

oscillation—To swing back and forth, such as the waving arm of a metronome. The electrical meaning is a complete cycle of alteration.

oscillator—A device that generates an electronic signal or pulse. In computers, an oscillator is used to run the **system clock**.

oscilloscope—See **cathode-ray oscilloscope**.

OSF—See **Open Software Foundation**.

OSI—See **open system interconnection**.

outline font—A type of font in which the outline of each character is defined by mathematical values. This type of font can be scaled to any size. Compare to **bit-mapped font**. See **scalable font**.

output—Information that comes out of a computer after processing. Output can be displayed on a screen, sent to a printer or other computer, or stored on disk..

output area—See **output buffer**.

output buffer—A place in memory where data on its way out of a computer is

held until the external device is ready to handle it.

output channel—See channel.

output device—Any peripheral that receives output from a computer. Printers and monitors are output devices.

output screen—The window of the display screen that shows a program's output. It also can be a separate monitor.

output stream—A steady stream of information on its way out of a computer to another device, such as a monitor or printer.

overclocking—Changing a computer system's hardware settings so it runs at a speed faster than what the manufacturer rated it to run. Doing so is a dangerous way to increase system speed since it risks damaging the central processing unit (CPU) and other parts of the computer's motherboard. It also leads to poorer system reliability. Most motherboards have jumper switches that set the speed of the computer, and these switches can be changed to make the system run faster than its rated speed. Overclocking is strongly discouraged by computer manufacturers and chip designers because of the damage it can cause. Intel, the leading manufacturer of personal computer microprocessors, is taking steps to make overclocking impossible with future chips and motherboards. See **chips**. See **remarking**.

OverDrive—A microprocessor from Intel Corp. The OverDrive microprocessor, which is sold to and installed by end users, not manufacturers, replaces 486SX or DX microprocessors, and functions such as a 486DX2, 486DX4, or Pentium microprocessor, depending upon the OverDrive model. The OverDrive either physically replaces the original microprocessor in the socket left empty when the original microprocessor is removed or is installed in an empty socket on the motherboard designed for this purpose. If the original microprocessor is left in place, it is disabled and the OverDrive microprocessor replaces it as the "brain" of the computer. See **microprocessor**.

overflow error—An error that occurs when a computer tries to manipulate a number beyond its capacity.

overlaid windows—See **cascade**.

overload protection circuit—A circuit that limits output to a computer or other electronic device so it isn't fed too much current.

overprint—To print one color over another without removing the original material.

override—To stop something from taking place. For example, in Windows 95, a user can override a program that has ceased to respond by pressing the CTRL-ALT-DEL key combination.

overrun—When information is lost because a device can't handle information at the rate that it is received.

overstrike—The printing of one character on top of another. This can be done to cross out a character or to create a new character.

overtype—See **overwrite mode**.

overwrite—To record information on top of previously recorded information, replacing the old with the new.

overwrite mode—One of two typing settings on a keyboard, overwrite mode allows new input to replace existing characters. The INSERT key is used to toggle between overwrite mode and insert mode, which shoves existing characters aside to make room for new ones. Also called typeover mode. See **insert**. See **insert mode**.

p-code—See **pseudocode**.

P2—See **Pentium II**.

P5—The pre-release code name for Intel Corp.'s Pentium processor. See **Pentium**.

P6—The pre-release code name for Intel Corp.'s Pentium Pro processor. See **Pentium Pro**.

pack—To compress data, or "smash" it together by taking out excess space, so it occupies less space when stored or transmitted. Compressed data must be decompressed before it can be used again. Compare to **unpack**. See **data compression**.

packaged software—A collection of programs created to fill the specific needs of a large variety of users, not specifically designed for one user or company. For example, Microsoft Office includes programs that can fill the basic word processing, spreadsheet, presentation, and scheduling needs of a home computer user or a corporate user. Compare to **custom software**.

packed file—A file that contains compressed data, which saves storage space and allows quicker transmission. See **pack**.

packet—A block of data transmitted from one computer to another on a network or on the Internet. A packet contains three parts: the data to be transmitted, the data needed to guide the packet to its destination, and the data that corrects errors that occur along the way. Several packets make up a typical transmission. The computer splits up the transmission at the transmission point and reassembles it at the destination.

packet filtering—A method for implementing firewall security by intercepting data packets, such as those comprising E-mail or documents, analyzing their origination and destination Internet Protocol (IP) addresses, and holding or forwarding the packets according to content. See **packet**.

Packet Internet Groper (ping)—Ping sends an Internet Control Message Protocol (ICMP) echo request message to the target host. The host bounces back the message, and the length of time it takes for the message to return is an indication of network speed. Use with care because remote computers may see it as a DoS attack, and the user's Internet service could be revoked as a consequence. See **DOS**.

packet loss—Occurs when only portions of a unit of information (packet) reach the intended destination. See packet.

packet sniffer—A sniffer on a Transmission Control Protocol/Internet Protocol (TCP/IP) network. See sniffer. See Transmission Control Protocol/ Internet Protocol.

packet switching—To break down a transmission over a network or the Internet into smaller parts called packets and split them up as they travel to their final destination, with each one taking the fastest possible route. The destination computer reassembles the packets into the original transmission as they arrive. See packet.

pad characters—The empty characters used to fill out a word field that has more character spaces than the user needs. For example, if a user types a seven-letter word into a field that requires 12 characters, five pad characters (such as the character for zero) can be added to the end of the word to fill the remaining space. Pad characters also may be used in data transmissions to fill up any unused portions by the transmitting device to ensure the entire packet arrives at its destination intact.

padding—To complete a word field with pad characters. See pad character.

paddle—An input device, similar to a joystick, that rotates. Games requiring action

Paddle

mimicking the motion of a car's steering wheel often use paddles.

page—A set amount of stored information in memory. In word processing and graphics programs, a page is the amount of information on-screen that would take up one printed page. On the Internet, a page refers to a single World Wide Web page.

page break—A symbol or line that marks the end of one page of text and the start of another on a computer screen. This mark may be placed by the program or the user to indicate that regardless of where the page would have automatically ended (given margin settings), the page must end at the

page down/page up keys

mark. A user might force a page break if he does not want a chart or section of text split between two pages.

page description language (PDL)—The computer language a PC uses to describe the content of a page to the printer. The printer uses the description to create the necessary images and text. There are a few common PDLs, such as Hewlett-Packard's Printer Control Language (PCL), but different printers use different PDLs.

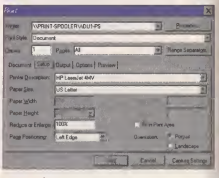
PAGE DOWN key—See PGDN key.

page fault—A signal used by a computer running with virtual memory that lets the memory controller know that a page, or block, of data is not available in physical memory and must be swapped back in from secondary storage (usually the hard drive). If the data can not be found in secondary storage or it is corrupted, a page fault error occurs, which usually crashes the computer or the program that called for the missing data. See page. See virtual memory.

page makeup—To gather and organize a page's graphics and text to prepare it for printing. This also can include page elements such as headers and page numbers.

page orientation—The placement of information on a page. There are two types of page orientation: landscape orientation and portrait orientation. See landscape orientation. See portrait orientation.

page printer—A printer that prints one full page of text or graphics at a time. The most common type is a laser printer. Compare to line printer.



page setup

page setup—The parameters defined by the user that help determine how a printed page will appear. Those parameters can include everything from the size of the margins on the page to the quality of print. A Page Setup dialog box is available in the File pull-down menus of many applications.

pages per minute (ppm)—A method of measurement for determining how fast a printer works, meaning the number of regular text-only pages a printer can produce in one minute. Laser printers usually offer the fastest ppm rate, and the average laser printer produces about 8ppm. The quality of print can greatly affect the speed, with a draft setting producing pages at a much faster rate than a letter-quality or higher setting.

PAGE UP key—See PGUP key.

paginate—To take a document, break it down into separate pages, and number the individual pages for printing.

pagination—The act of breaking down a document into pages or numbering pages prior to printing. Pagination is often done automatically by word processing programs.

Users can determine where page breaks should fall if they believe the program's suggested page breaks seem awkward.

paint program—A graphics program that lets the user draw new bit-mapped, or raster, graphics or alter existing images on their display screen. Most paint programs offer a variety of tools for working on these images, from line drawing tools to spray paint cans to erasers. Compare to drawing program.

palette—The set of available colors in a given computer graphics program or computer system. Palette also can refer to the

palette

collection of tools in paint programs used for creating and altering images.

palmtop computer—A PC that fits in the palm of the user's hand. In the past, most palmtop computers had relatively limited capabilities, mainly because of their severely limited amount of storage space and their inability to easily connect to desktop PCs.

palmtop computer

Most of the early palmtops served as high-tech message pads and personal telephone books. Today's palmtops offer improvements in handwriting recognition software, thus making them easier to use than their predecessors. Also, the newest palmtops connect easily to larger PCs and exchange information. New palmtops don't even need to physically connect to a desktop PC to transfer information; the Palm Pilot and Windows CE-based devices are equipped with an infrared transmitter for connections when the unit is set next to the desktop. Some palmtops come equipped with basic word processing or spreadsheet programs and modems for sending and receiving faxes and E-mail messages. Also referred to as handheld computers or personal digital assistants (PDAs).

panic—A slang word for a crash or a fatal error that causes a computer to crash.

Pantone Matching System (PMS)—A standardized color system wherein 500 specific colors are assigned a number. Since most professional printing outlets use the Pantone system, clients can select any one of the standard colors from a swatch book by number and know exactly what the output will look like regardless of the printing mechanism used.

paper feed—The method or system by which paper moves through a printer. The paper feed method in a dot matrix printer, for example, is called the pin feed. In more advanced printers, dual pressure rollers pinch the paper and pull it through the printer as they rotate.

paperless office—The idea of creating and storing all office information and documentation in computers, eliminating the need for paper. The idea originated in the 1980s and has suffered as the use of personal printers, fax machines, and other paper-friendly devices has grown. Continued improvements in technology and a fundamental shift in what people perceive to be "official documentation" must occur before a truly paperless office can exist.

paper-white—A monochrome monitor that displays characters in black against a pure white background. Often used in desktop publishing, because it looks like type on normal paper.

paragraph formatting— To make changes to text that will affect an entire paragraph. Examples include indenting the first line, centering the text, inserting an additional space, or setting special margins to make the paragraph stand out from the rest of the document.

parallel—Describes processes that happen at the same time. In a data transfer, parallel means the transmission of more than one bit of information at one time.

parallel access—Simultaneously saving or retrieving all the bits of a unit of information at the same time rather than sequentially.

parallel cable—A 25-pin cable used to connect peripherals to the parallel port. See parallel port.

parallel computer—A computer that uses more than one microprocessor at once. A parallel computer can handle more tasks, at a faster rate of speed, than a machine with a single microprocessor. Examples of parallel computers include supercomputers built to do complex jobs, or server systems designed for larger networks.

parallel execution—The execution of two or more processes at the same time. Such a feat requires more than one microprocessor, but the apparent simultaneous execution of multiple processes can be accomplished by breaking down the tasks into tiny slices and causing the CPU to switch back and forth between them.

parallel interface—A data transmission scheme that sends information over wires connected in parallel. A parallel interface allows for the transfer of more than one bit of data at a time. This type of channel is usually found between a computer and a peripheral, the most common on a PC being the parallel port used to connect the printer to the computer. Compare to serial interface.

parallel port—The computer interface outlet or plug where an external parallel device (such as a printer) can be connected to a PC. This type of port allows more than 1 bit of data to be transmitted at once. Compare to serial port.

parallel printer—A printer that uses the parallel interface to connect to a PC.

parallel processing—A program execution method that requires the use of more than one microprocessor. Parallel processing divides the tasks evenly among the available microprocessors and can add greatly to the speed of a program; however, it can be

tricky for programmers to figure out how to evenly divide the work between the processors to accomplish the job.

parallel transmission—In telecommunications, sending a packet of information over two or more wires at the same time. Compare to **serial transmission**.

parameter—The preferences and commands used to define the characteristics of items such as a file or page. A parameter also can be a value sent to an operation by the user in a program. For instance, you might tell DOS what drive you want formatted by adding the a: parameter to the FORMAT command. Or you may add the /V parameter after the FORMAT command to tell DOS to create a volume label.

C:\WINDOWS>move a:\poetry c:\britlit

parameter–In this example, the file Poetry is a parameter for the A: drive, the directory Britlit a parameter for the C: drive. DOS is limited by what the parameter is; DOS cannot move the Poetry file to any other directory in the C: drive except Britlit.

parameter-driven—A program in which the parameter values a user sets up help to determine the outcome. Parameter-driven programs are often used by another program; in this situation, the parameters would be set by one of the programs instead of the user.

parameter RAM (PRAM)—(Pronounced P-ram.) A small, battery-powered section of RAM in a Macintosh computer used to store basic settings such as the time and date.

PARC—(Pronounced "park".) See **Xerox Palo Alto Research Center**.

parent/child—In file maintenance, how two files can be related. The parent contains essential basic information files, while the child contains a single, more specific file. Also can refer to the relationship between two processes in a multitasking environment. A parent process will usually wait to perform its operation until a child process can complete its own.

parent directory—The directory that sits above another directory or group of files. Every file has a parent directory, except the root directory, which is at the highest level and serves as parent to all directories on a drive. Also known as an upper directory or a higher directory. The directory beneath a parent directory is the child directory or subdirectory.

parity—An error-checking procedure in which PCs check the accuracy of transmissions. Binary data moves in streams using a series of 0s and 1s. Before the information is sent, the bits are counted. When the total number of bits is odd, the ending transmission should also have an odd number of bits. When the original transmission has an even number of bits, the ending transmission should, too. If there is a difference between the original transmission and the one on the receiving end, it is clear a transmission error occurred. When this happens, the transmission is retried or the system stops and the user receives an error message. There are two types of parity: per-character, called vertical redundancy checking, or block-by-block basis, called longitudinal redundancy checking. See **vertical redundancy check**. See **longitudinal redundancy checking**.

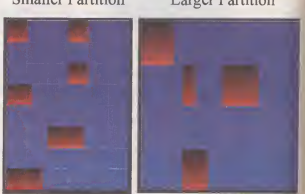
parity bit—An extra bit added to a data transmission to reveal errors. The sending computer adds an extra bit to each group of data bits in a transmission. The setting of the parity bit is hinged on the type of parity used, even or odd. For even parity, the parity bit is set to 1 whenever it is needed to bring the total number of bits to an even number. The converse is true for the odd setting; then, the parity bit is set to 1 whenever the total number needs to be odd. After the computer adds the needed parity bits, it knows whether the transmission should end even or odd. When the transmission is made, the receiving computer checks the number to make sure it matches. If it does, the transmission arrived intact. If the number does not match, the computer can assume there was an error in the transmission. See **parity**.

parity check—A PC's process of checking to make sure a data transmission was sent and received correctly. There are two types of parity checks: a vertical redundancy check (VRC) and a longitudinal redundancy check (LRC). See **vertical redundancy check**. See **longitudinal redundancy check**.

park—To lock a hard drive read/write head into position before physically moving a computer. This "parking" keeps the head and disk platter safe from damage when a hard drive is transported, something that is particularly important with portable computers. Most newer hard drives park automatically whenever the user turns off the computer's power supply. Then when the PC's power is turned back on, the hard drive "unparks" automatically as well. Parking also can be performed manually by a disk utility program.

parse—To break down input into smaller, more functional pieces. Once the data is broken down into smaller units, the program can translate the input commands and structures into machine code for the computer to read.

partition—A reserved portion of disk or memory that functions as a separate unit; when used as a verb, partition refers to the process of dividing up the space on a disk into smaller units. A partition acts as a sep-



partition (red represents data)–Smaller partitions on a drive store data in smaller clusters and often waste less space.

When Smaller Is Bigger

As this chart shows, smaller hard drive partitions store files more efficiently in small clusters. That means less wasted space and more room for storing files.

Minimum & Maximum Partition Sizes	Minimum Required Cluster Size	Typical Wasted Space
16 - 127MB	2KB	2%
128 - 255MB	4KB	4%
256 - 511MB	8KB	10%
512 - 1,023MB	16KB	25%
1,024 - 2,047MB	32KB	40%
2,048 - 4,096MB	64KB	50%

Source: PowerQuest Corp.

arate space, but physically it is still part of the whole disk. A user could, for example, partition a hard disk into several separate drives (such as E:, F:, and G:), while maintaining the physical structure of only one disk. This is a way to make the hard drive more efficient. Hard drives partitioned into multiple sections often work faster because the computer only needs to search a specific section for information rather than the entire drive.

Pascal—A high-level programming language created by Niklaus Wirth in 1971. Pascal is a very structured language, and because of this, it is a very popular tool for teaching new programmers.

passive heat sink—A type of heat sink that relies entirely on convection (the transfer of heat from one object to another), rather than air cooling from a fan, to cool microprocessors. Passive heat sinks are generally a large block of metal, usually aluminum, placed on top of a microprocessor to carry heat up and away from the microprocessor. Compare to active heat sink. See heat sink.

passive-matrix display—A type of screen display used mostly for portable computers that uses liquid-crystal display (LCD) technology. A passive-matrix display has a series of criss-crossed wires with an LCD element at each intersection. Each of those LCD elements amounts to a single pixel that can either allow light to pass or not. A passive-matrix display cannot produce the same level of quality image an active-matrix display can. Compare to active-matrix display. See liquid-crystal display.

password—A set of secret characters or words needed to gain access to a computer or to files and programs within the system. Passwords ensure that only authorized users can reach certain information.

password protection—The actual implementation of a password system in order to protect a computer or files from unauthorized users. See password.

paste—To insert a piece of text or a graphic into a document from a clipboard by placing the cursor over the insertion point and choosing the Paste option from the Edit menu in a word processing, spreadsheet, desktop publishing, presentation, or graphics program. See cut. See cut and paste.

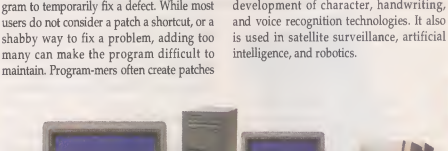
patch—A piece of code inserted into a program to temporarily fix a defect. While most users do not consider a patch a shortcut, or a shabby way to fix a problem, adding too many can make the program difficult to maintain. Program-mers often create patches to add features to a program while users await the release of a new version of the software that includes the "patched" features.

path—The course between two points, such as the link between two PC stations. Also refers to the series of commands given to a computer in a software routine or the route the computer needs to take to find, store, and retrieve a data file.

path name—The file name designation that shows the user where to find a file in a hierarchical system. For example, the path name C:\NOVICE\ STORY\Index.doc indicates the file Index.doc is in a directory called STORY that resides in the NOVICE directory on the C: drive.

passive heat sink

pattern recognition—A technology describing a computer's ability to see and match visual and audio patterns that have been converted to an array of numbers. To do this the image or sound must be converted into a digital signal the computer can read. Then the computer matches the input against a set of patterns it has stored. Pattern recognition is important in the development of character, handwriting, and voice recognition technologies. It also is used in satellite surveillance, artificial intelligence, and robotics.



path

PAUSE key—A keyboard key that allows users to temporarily stop the action on-screen so they can read the information as it scrolls quickly down the display. Also, many games use the PAUSE key to let a player stop the action for a break.

PC—See personal computer.

PCB—See printed circuit board.

PC board—See printed circuit board.

PC Card—A credit card-sized device that plugs into a PC Card slot and enables the user to add additional computer peripherals including modems, sound cards, and CD-ROM drives. They are used primarily in portable computers but can be used in desktop systems as well. There are three sizes of PC Cards: Type I cards (3.3mm thick) often

PC Card–A Type 1 PC Card is very close in size to a typical credit card.

are used for adding RAM and ROM; Type II cards (5mm thick) usually are used for adding modems; and Type III cards (10.5mm thick) are sometimes used for adding a portable disk drive. Developed by the Personal Computer Memory Card International Association (PCMCIA), PC Cards were originally called PCMCIA cards.

PC Card slot—An opening in a computer into which PC Cards can be inserted. PC Cards add functionality such as extra memory, modems, sound cards and other components to portable computers, although some desktop computers also use PC Cards. PC Card slots come in three types. Type I slots hold a Type I card; Type II slots hold either a Type II or a Type I card; and Type III slots hold a Type III card or two Type I or Type II cards. Also called PCMCIA slots after the Personal Computer Memory Card International Association, although PC Card slot is the more current term. See **PC Card**.

PCD format—See photo CD.

PC DOS—An acronym for Personal Computer Disk Operating System. A text-based operating system, nearly identical to Microsoft's DOS, but marketed instead by IBM. See **DOS**.

PCI—See **Peripheral Component Interconnect**.

PCL—See **Printer Control Language**.

PCM—See **pulse code modulation**.

PCMCIA—See **Personal Computer Memory Card International Association**.

PCMCIA slot—See **PC Card slot**.

PC memory card—A PC card designed to add memory by adding battery-powered RAM chips. The card is inserted into a portable computer's PC card slot. The most common type of PC memory card is a Type I PC card.

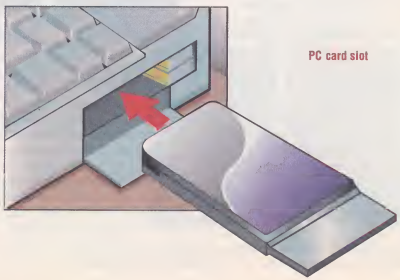
PCI-X—Short for PCI-extended, this is an enhanced version of the Peripheral Component Interconnect bus that increases the top speed of the bus from 66 megahertz (MHz) to 132MHz. It hasn't yet been introduced into computers, but should hit the market by the end of 1999. PCI-X will be backwards compatible with existing PCI cards. See **Peripheral Component Interconnect**.

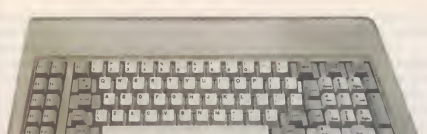
PCX—A file format for storing bit-map graphics, signified by a .PCX file extension. The format was originally developed by the popular DOS graphics utility PC Paintbrush and remains a graphics file standard. Many scanner software utilities still support the PCX format. The other two common formats for bit-mapped images are .BMP and TIFF. See **bit map**. See **tagged image file format**.

PC/XT keyboard—The 83-key keyboard sold with the original IBM PC. It was both applauded and criticized for its changes from the standard typewriter keyboards. Those changes included making several keys (such as the ENTER key) smaller than usual, and adding several keys, including the 10 function keys.

PDA—See **personal digital assistant**.

PDF—See **Portable Document Format**.





PC/XT keyboard

PDL—See page description language.

peer—A computer that exists on the same level as another with similar access privileges on a network.

peering—An arrangement between two or more Internet service providers (ISPs) to connect their networks in an effort to speed communication between them. If two ISPs are in the same town but have different network service providers (for example, one uses MCI for its connection to the Internet backbone while the other uses Sprint), even if they are only a few blocks apart, messages sent over the Internet between the two ISPs will travel hundreds or thousands of miles across the Internet backbone to reach their destination. Peering allows the ISPs to connect their networks at the local level so that data transfers between the two ISPs can be expedited. That ensures that each ISP's connection to the Internet backbone is being used solely by their customers, not for traffic coming through the peering connection. Some cities have peering points to which any ISP in town can connect for free or for a minimal charge. This saves ISPs money—because it cuts down on the amount of traffic on their Internet backbone connection, for which they pay handsomely—and lets customers pull up their neighbors' home pages faster.

peer-to-peer communications—The transmissions between two peer computers connected on the same level in a network configuration.

peer-to-peer network—A network setup where the server is non-dedicated, meaning it is also a workstation. Every computer acts on its own by storing files and accessing peripherals (such as printers) and can see every other computer on the network if it has the proper access privileges. This formation is used primarily in smaller networks of less than a dozen computers. See **client/server network**.

PEL—See pixel.

pen—See light pen.

pen computer—A type of handheld computer or personal digital assistant (PDA) in which the user interacts with the computer through a pen device instead of a keyboard. Pen computers need a specialized operating system because they rely on handwriting recognition to receive a user's commands and data. Because of their small size, pen computers usually do not have a traditional memory storage unit, such as a hard drive; they use ROM and flash memory for storage instead. Most provide some method for exchanging data with a regular desktop computer.

pen plotter—A printer, specifically for graphics, that uses one or more colored pens to create an image on paper. The image is made by using software that directs the pen(s) to draw connecting lines from point to point.

Pentium—The CPU released by Intel in 1993 to replace the 486 processor. The Pentium processor is faster and more powerful than Intel's earlier chips, with about 3.1 million transistors, compared to 1.2 million on the 486 and 275,000 on the 386. The Pentium has a 32-bit address bus and a 64-bit data bus, and it can operate at speeds of 60MHz to 200MHz. Intel has another line of processors called the Pentium Pro that it targets at businesses. During 1997, Intel introduced the Pentium II processor that combined features of the Pentium Pro with MMX. In February, 1999, Intel released its latest generation of processors called Pentium IIIs. See 586. See 686. See MMX. See P2. See Pentium Pro.

Pentium II—A new architecture for microprocessors introduced by Intel in 1997 that run from 233MHz to more than 400MHz. Informally called P2 for short by many users, the CPUs combine Pentium Pro technology with MMX technology, but in a new physical format. The Pentium II CPU is

Pentium with MMX

Pentium II

Pentium Pro

encased on a card with other circuitry. Systems cannot be upgraded to Pentium II CPUs unless they have a Slot 1 motherboard designed to accept the card.

Pentium III—The latest microprocessor from Intel, introduced in February, 1999. The processor includes 70 new instructions and upon introduction offered speeds of 450MHz and 500MHz. Several months later Intel rolled out chips running at 550MHz, and faster speeds are on the way.

Pentium Pro—A microprocessor line from Intel designed for corporate use in high-end servers and workstations, particularly those using Windows NT. Pentium Pro CPUs are extremely fast with 32-bit applications and 3-D image processing and rendering. The chips run at 166MHz and higher.

peripheral—Any device connected to the computer that performs a specific function. Printers, keyboards, disk drives, and monitors are among the most common types of peripheral devices.

Peripheral Component Interconnect (PCI)—The Intel local bus standard that allows for faster communication between a computer's CPU and peripheral components, thus speeding up operating time. Most PCI buses co-exist on a motherboard with an Industry Standard Architecture (ISA) or Extended Industry Standard Architecture (EISA) bus, so the user can plug in expansion cards compatible with either standard. An advantage to the PCI bus is its Plug-and-Play capability, which means it can help an operating system such as Windows 95 detect and configure new cards when they are placed in a PCI slot. See CPU. See plug and play.

Perl—See Practical Extraction and Report Language.

permanent storage—A way of holding information for extended periods of time. In reference to computers, permanent storage is often in the form of a diskette or a hard drive. The most common method of permanent storage is paper.

permission—The authorization given when an individual, such as a systems or network administrator, grants a network user access to information or resources stored on that network.

permission marketing—A strategy for advertising on the Internet which shuns practices that interrupt potential customers (such as spam or the commercials that interrupt their favorite TV show) in favor of getting people to ask or "raise their hands" for more information. The term and strategy were coined by Seth Godin, a direct marketing guru and vice president of direct marketing at Yahoo!. The strategy works by giving something to get something, like providing information resources at a Web site or an online game, contest, or sweepstakes. In return, those who participate give a company permission to send them information. As part of the strategy, the company should not alienate potential clients by giving out its E-mail lists to other companies. It should also maintain its relationship with those potential clients by being both selective and conservative about the scope and frequency of the E-mail sent.

persistence—The momentary lingering of previous images on a changing computer display.

personal computer (PC)—A computer designed for use by a single user, with everything a user could need for basic computing, including the ability to process and store information. IBM introduced its first single-user computer as the IBM PC in 1981, and in the last 15 years, the term has come to represent any computer based on the IBM standard. The other standard in the personal computer market is the Apple Macintosh. Software and peripherals specify whether they work on IBM-compatible PCs or Apple Macintosh platforms. In addition to standard abilities such as word processing, PCs have brought a wide variety of new possibilities to home users. Today a PC can be used to play high-tech video games, access huge amounts of information, and contact people around the world. The growth of the Internet and the World Wide Web has opened up a vast new world of opportunities for PC users.

Personal Computer Memory Card International Association (PCMCIA)—A trade association founded in 1989 by a group of computer manufacturers, the PCMCIA established the PC card standard, which has greatly expanded the potential capabilities of portable computers. PC cards, also called PCMCIA cards, are credit card-sized devices that offer everything from expanded memory to modem connectivity to network adapters. See PC Card.

personal digital assistant (PDA)—See palmtop computer.

personal identification number (PIN)—(Pronounced pin.) A set of personal numbers used to prove positive identification. Often used with automated bank teller machines and telephone calling cards.

personal information manager (PIM)—(Pronounced "pim".) A program that helps users get more organized. PIMs often include calendars, telephone lists, and programmable reminders that are easy to use. Some PIMs included in operating systems or office suites also can be purchased separately. Some of the best-known PIMs include Microsoft Schedule+ and Starfish Software's Sidekick.

personal search agent (PSA)—See agent.

perspective view—In drawing and graphic programs, a display method that

perspective view

shows a three-dimensional image. These three dimensions, height, width, and depth, create an image on-screen that more closely resembles what the human eye actually sees. See **isometric view**.

PGDN key—(Pronounced page down.) A keyboard key, usually located in the section between the alphanumeric keys and the 10-digit keypad, that moves the on-screen cursor down through an entire page of text with one strike of the key.

PGUP key—(Pronounced page up.) A keyboard key, usually located in the section between the alphanumeric keys and the 10-digit keypad, that moves the on-screen cursor up through an entire page of text with one strike of the key.

phase change—The technology used in CD-Erasable disc drives. A laser changes areas of the disc material from an amorphous state to a crystalline state, each generating a different level of reflectivity. These different levels are then read as the 0s and 1s that make up the binary code of digital data. See **CD-eraseable**.

phase-change alloy—The media component that allows CD-Rewriteable (CD-RW) drives to work and what sets them apart from CD-Recordable (CD-R) drives. The alloy forms the recording layer of the CD and can change phases between crystalline and amorphous states (amorphous when data has been recorded on it and crystalline when it's been erased). CD-RW discs convey digital data in binary bits by setting certain sectors of the discs to be either amorphous or crystalline. CD-RW drives can determine which state a sector is in by whether it reflects light. Crystalline sectors reflect light, but amorphous sectors do not.

phone connector—The device at the end of a phone line used to connect the line into a computer's modem. The device has a small clip that retracts slightly when the connector is installed in the modem. It clicks out and locks into place once the connector is in exactly the right position.

phoneme—(Pronounced fo-neem.) The smallest unit of speech. A phoneme helps define different sounds. The difference between the pronunciation of the words bar and jar are the phonemes B and J. Phonemes are used in synthetic speech to compose computer speech for audio output.

phosphor—A substance that emits light after being stimulated by radiation. Phosphors are used to coat the inside of cathode ray tube computer display screens (similar technologically to TVs). When the screen is charged with electrons, it glows as a result of the phosphors. To produce a full-color display, red, green, and blue phosphors are clustered together in groups called pixels.

photo CD—A standard for saving and organizing digitized photos onto a CD-ROM, as well as a standard for digitizing images. Many processing labs now have the capability to put photos onto a photo CD. The standard, developed by Kodak, saves 100 images per disc, each taking about six megabytes (MB) of space on the disk. Each 35mm image is put into an "ImagePac," which has five versions of varying resolutions: a thumbnail for previewing images; a low resolution version for draft copies; medium resolution for inclusion in Web pages, printing on 300 dots-per-inch (dpi) printers, and for viewing on television and computer monitors; a high-resolution version for high-definition television (HDTV) and 600dpi printers; and a full resolution for output on very high resolution printers. Photo CD (with a .PCD extension) is also a standard for digitizing images, similar to the JPEG and GIF formats. Many image-editing programs such as Adobe Photoshop recognize files in .PCD format. To read photo CDs, a CD-ROM drive must be capable of reading multi-session CD-ROMs. See **multi-session**.

photocomposition—The design and production of a printed page using photographic and electronic devices. The most common of these machines are phototypesetters and laser printers.

photolithography—A technique used to create an integrated circuit. In photolithography, the circuit pattern is created, photographed, and reduced to a negative image called a photomask. The photomask is placed over a wafer (a thin, flat piece of semiconductor crystal), which is coated with light-sensitive material. The photomask and the wafer are then exposed to light. The areas where the light shines through the photomask onto the wafer become the hardened circuit paths. The photoresistive residue is removed using an acid bath or dry-ion etching process. See **wafer**.

photo manipulation program—Software that offers the tools necessary to alter a scanned photo image. See **photo retouching**.

photorealism—The computer reproduction of an image in desktop publishing, software creation, and computer graphics that is close to a real photograph. Creating such an image is a difficult process, and it requires a great deal of computer power, as well as software specifically designed for creating these reproductions.

photo retouching—To improve a scanned photo image using the tools available in a photo manipulation program. Improvements can include everything from more refined colors to improved clarity.

photo scanner—An optical scanner designed for scanning photos only, as opposed to scanners that can scan large illustrations or pages of text. Photo scanners can't perform optical character recognition (OCR), but they generally offer decent scanning quality at a lower price than scanners with more features. Some photo scanners read film negatives instead of printed photographs. See **optical scanner**.

photosensor—A highly sensitive device that converts light into an electrical signal. Solar-powered devices use photosensors.

phototypesetter—A high-resolution, text-only printer that generates camera-ready film.

physical—A term used to describe anything that has to do with computer hardware, defined as real and not logical. The major difference between physical and logical objects is that physical objects can be touched or felt and logical objects exist only abstractly. Compare to **logical**.

physical address—An actual hardware-based location within a computer. For example, a computer's hard drive has a physical location denoted in memory by the physical address that the processor knows to access when it seeks material stored there.

physical format—See low-level format.

physical layer—The first layer in the seven-layer Open Systems Interconnect (OSI) standardized model of computer network communications. This layer contains the wires and physical interfaces that connect a network of computers. See Open Systems Interconnect.

physical memory—The amount of actual memory in a computer. If a PC has two 8-megabyte (MB) single in-line memory modules (SIMMs) installed on its motherboard, it has a total of 16MB physical memory. Also called physical storage and real storage. Compare to virtual memory.

physical storage—See physical memory.

pica—A unit of measure used in typesetting and page design. There are six picas in an inch.

picklist—See list box.

picture element—See pixel.

pie chart—A round chart that is divided, or sliced, into sections. Each section represents percentage values of a whole.

piezoelectric—(Pronounced PEEzo-electric.) The ability of certain crystals to convert mechanical energy into electric energy and vice versa. Piezoelectric crystals might be used in a microphone, for instance, to convert sound waves in the air to electric signals. Some sonar transmitters use piezoelectrics in the opposite way to transform electrical signals into sound waves that are transmitted into water.

.PIF—See program information file.

piggyback board—A small circuit board that plugs into another larger circuit board instead of a slot on the motherboard. Piggyback boards increase the capabilities of the original circuit board. See daughterboard.

PIM—See personal information manager.

pin—A short, thin piece of metal on the plug-end of a cable, called the male contact point. Most connectors have a series of five or more pins. With the female receptor end, it completes a circuit. A computer processor chip also has a series of pins that surround the chip and fit into a socket on the motherboard. Also called connector pin.

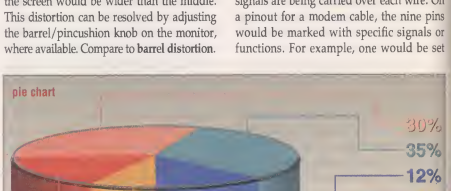
PIN—See personal identification number.

pin-compatible—Describes two electronic devices that have the same type of connector pins, with the same input and output abilities. These two devices can replace each other and can be plugged into the same socket.

pincushion distortion—A type of distortion on a computer monitor in which the left and right sides of the screen bend toward the center of the monitor. The top and bottom of the screen would be wider than the middle. This distortion can be resolved by adjusting the barrel/pincushion knob on the monitor, where available. Compare to barrel distortion.

pin grid array—A way to mount chips on circuit boards. In a pin grid array a large number of pins, or electrical connectors, are placed in a small space by putting the pins on the bottom of the chip rather that just along the sides. Many CPUs use pin grid arrays to connect to motherboards.

pinout—A list of the functions of each wire in a cable and, accordingly, each pin in a cable connector. A cable, for example, may have nine wires with nine pins—one at the end of each wire. A pinout of such a cable would specify the use of each of the nine pins and wires, specifically what sorts of signals are being carried over each wire. On a pinout for a modem cable, the nine pins would be marked with specific signals or functions. For example, one would be set



pin feed—A way to move paper through a printer. Rotating pins on ends of the platen catch the prepunched holes in the paper and move it through in a continuous motion. This is commonly used on dot matrix printers. Also called tractor feed or sprocket feed.

ping—See Packet Internet Groper.

ping pong—A communication method that only allows one participant to transmit at a time. One side sends a message, the line switches from send to receive, and the other side sends a reply.

ping pong buffer—A communications buffering method that involves two buffers: one buffer receives transmissions while the second deletes earlier transmissions. The two alternate functions, which helps to keep transmissions close to continuous.

aside for sending data-terminal-ready (DTR) signals, another for clear-to-send (CTS) signals. Pinouts differ widely, even on cables with the same number of wires. For example, the wires in a 25-pin Small Computer System Interface (SCSI) connection serve different functions than those in a 25-pin parallel port connection, and the pinouts reflect that.

pipe—A temporary section of computer memory that can link two different computer processes. The output of one process can be linked to the input of another to increase overall efficiency.

pipe key—This piping or pipe character appears as the sort pipe combination; as DOS lists its directories, it can then sort them. The piping process uses a portion of memory to pipe information from one command to the other.

pipeline—See pipelining.

pipeline burst cache—A type of secondary (or level 2) cache technology. It offers a significant speed boost by loading the next block of requested memory while sending another, in effect, reading and writing at the same time. Previous cache technologies could only do one thing at a time. Pipeline burst cache replaced asynchronous cache, which had been incorporated into motherboards using 486 series and earlier microprocessors. Pipeline burst caches are significantly more efficient at fast speeds than asynchronous cache and synchronous burst cache. With processors slower than 60 megahertz (MHz), pipeline burst is actually slower than the other two standards, but at speeds of more than 60MHz, and especially more than 100MHz, pipeline burst caches are much faster. The speed boost offered by pipeline burst cache is vital for speeding up the computer by reducing the amount of time the computer spends waiting for data to be retrieved from memory. See cache. See Level 2 caching. See memory.

pipelining—An advanced microprocessing technique in which the CPU handles several stages of different instructions at one time. In pipelining, the processor never has to wait, there is always a program instruction awaiting completion, and the overall process increases in speed. For instance, Intel's Pentium processor makes use of pipelining technology and can perform up to four instructions at one time.

piracy—See software piracy.

pitch—A measurement in word processing and desktop publishing used to measure how many fixed-width characters fit into an inch of space. This is only absolutely accurate in monospacing fonts because each character is given an equal amount of space.

pixel—The smallest part of an image that a computer printer or display can control. An image on a computer monitor consists of hundreds of thousands of pixels, arranged in such a manner that they appear to each be connected. Each pixel on a color monitor comprises three colored (blue, red, and green) dots. The term comes from the words picture element, and also is abbreviated PEL (pronounced pell).

pixel image—A description for the way a color image is stored in a computer's memory. Each pixel requires a certain amount of storage space to make up a complete image.

pixel map—See pixel image.

PKUNZIP—(Pronounced P-K unzip.) A decompression program that expands files that were compressed by PKWARE Inc.'s PKZIP and compatible programs. See PKZIP.

PKZIP—(Pronounced P-K zip.) A compression program that compacts files so they take up less storage space. In order to use a compressed PKZIP file, the files must first be decompressed using PKUNZIP or a compatible program. See data compression. See PKUNZIP.

Plain Old Telephone Service (POTS)—See analog phone line.

plaintext—A text format that is simple, readable, and does not contain any encrypted messages or formatting commands. It can be read using nearly any word processing program or text editor.

plane—A grid, chart, or graph designed to measure the placement of a point in relation to the x-axis (horizontal), y-axis (vertical), and z-axis (third dimension). In computer technology, planes are helpful when tracking the mouse or cursor position on a grid, such as a computer monitor, a template of a desktop publishing document, or a digitized tablet. See x-axis. See y-axis. See z-axis.

plasma display—See gas-plasma display.

plastic leadless chip carrier (PLCC)—A cheaper version of the leadless chip carrier socket method for attaching a CPU to a motherboard. Leadless chips have none of the tiny pins often found on microchips. Instead, they fit into a special socket to make electrical contact with the motherboard. The leadless chip method often takes up less space than a chip with leads. Compare to leadless chip carrier.

platen—The rolling mechanism in an impact printer or typewriter that the paper is held against as it is printed upon.

platform—The standards that set the parameters for what a system can and cannot do; includes most basic hardware and software on a PC. One example of a platform might be a Hewlett-Packard computer with a 400MHz Intel Pentium II CPU running Windows NT. Once you understand the platform, you can begin to understand what the system is capable of and what types of tasks it can be used for.

platter—The circular disk inside a hard drive that holds the actual information. There are multiple platters inside a single hard drive. See hard drive.

PLCC—See plastic leadless chip carrier.

plot—To draw an image by connecting a series of precisely placed points on a surface, using a series of lines.

plotter—A computer-driven device that creates a precise image using a series of lines. Plotters are more exact (and expensive) than regular printers and work well with graphics programs.

Plug and Play—The ability of a computer to detect and configure new hardware automatically, with almost no intervention from the user. Apple's Macintosh computers have long used Plug and Play (PnP) technology, but PC users had to wait until Windows 95 brought a Microsoft-Intel version of PnP to their machines. Without Plug and Play, it is often necessary to manually change hardware settings in order for the computer to recognize the new component. That usually means resetting tiny jumpers or dual inline package (DIP) switches. When a computer is equipped with a PnP operating system such

as Win95 and a PnP BIOS on the motherboard, it is a simple process to have the machine find PnP devices such as modems, sound cards, and other components on its own.

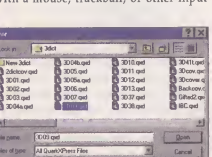
plug-compatible—A piece of hardware that can easily connect to another through the use of a standardized connection device. A plug-compatible device from one company is replaceable with a plug-compatible device from another company.

plug-in—Scripts, utilities, or instructions that add to the functionality of a program without changing the program's base code. Plug-ins provide a way to add functionality to an application without completely upgrading. Applications that can accept plug-ins often have a built-in way to accommodate them. Two common applications which use plug-ins are Adobe Photoshop and Netscape Navigator. The Macromedia Shockwave plug-in, for example, allows special animated World Wide Web content to be displayed in Navigator. With Photoshop, plug-ins can contribute special effects and filters that weren't included in the original program.

PMS—See Pantone Matching System.

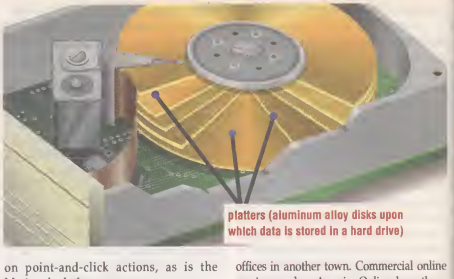
point—To move the on-screen cursor using an input device such as a mouse, trackball, or touch pad. Also, in typography, a point is a unit of vertical measure. There are 72 points in one inch. Compare to pica.

point-and-click—To move the pointer over an icon or file and open it by clicking it with a mouse, trackball, or other input



point-and-click

device. Point-and-click interfaces are very user friendly. Microsoft's Windows 3.x, Windows 95, and Windows 98 are all based on point-and-click actions, as is the Macintosh platform.



platters (aluminum alloy disks upon which data is stored in a hard drive)

point chart—A chart that compiles values from one or more sources of data and sets them down at exact points. Used for comparing different values. Also called a point diagram.

point diagram—See point chart.

pointer—An on-screen symbol in a graphical user interface that lets the user navigate the screen through the use of an input device, such as a mouse or a trackball. A pointer usually takes the shape of an arrowhead or something similar. Also, a variable that indicates the location of data for programs trying to retrieve it. See dereference.

pointing device—An input device that lets a user manipulate a pointer in a graphical user interface. Common pointing devices include the mouse, trackball, lightpen, and joystick.

polarity—The direction that charged particles will travel. Convention says current flows from positive to negative.

Point of Presence (PoP)—(Pronounced pop.) A point where access to a network, such as the Internet, can be established through telecommunications equipment, such as modems. Internet service providers generally maintain points of presence where banks of modems let users dial in with a local phone call to reach a digital line to the Internet. Regional or national ISPs set up PoPs in many cities so customers don't have to make a long-distance call to reach the ISP offices in another town. Commercial online services, such as America Online, have thousands of PoPs across many countries that they either run themselves or rent time on through a third party.

point-of-sale (POS) computing—The process of using computer technology to record all pertinent data involved in a transaction when a consumer purchases an item, normally by scanning the item's Universal Product Code (UPC). When the scanner picks up that code, it not only tells the user the price of the item but it also records that the item is being sold, so the store's inventory can be updated accordingly.

point size—A measurement used to describe the height of a printed character. A single point is 1/72 of an inch.

Point-To-Point Protocol (PPP)—A communications protocol that lets users connect their PCs directly to the Internet through a phone line or other full-duplex link, such as ISDN. With dial-up PPP software and a modem, a computer can call in to an Internet service provider and establish a connection to the Internet that allows E-mail, World Wide Web browsing, and other capabilities. Compare to Serial Line Internet Protocol (SLIP).

polling—A constant routine in which a PC checks all of its connected devices individually to see if there is any new information there. Network computers check all of those connected to it.

polling cycle—The amount of time for a computer to obtain certain data from each

device or computer to which it is connected. See **polling**.

polyline—A computer graphic composed of lines that connect together numerous defined points. When the lines connect all the points, they form what appears to be a continuous line.

PoP—See **Point of Presence**.

POP—See **Post Office Protocol**.

POP3—Version three (at publication date the most recent) of the Post Office Protocol. See **Post Office Protocol**.

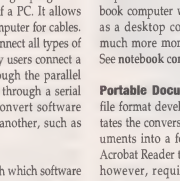
pop-up menu—A menu that appears when a user moves the pointer over a button on the screen and clicks the mouse. Once the user makes a selection from the menu, it disappears again. Compare to **tear-off menu**.

populate—To place additional components on a circuit board. Another name for a completely full board is a fully populated board. Compare to **unpopulated board**.

port—A device, resembling a plug-in of sorts, found on the back of a PC. It allows access in and out of the computer for cables. The ports can be used to connect all types of devices. For example, many users connect a printer to a computer through the parallel port and connect a mouse through a serial port. Also, to port is to convert software from one environment to another, such as from Windows 95 to Unix.

portability—The ease with which software can be moved from one computer or operating system to another. Portability can be defined as either high or low. High portability implies the software is easily moved to other systems; low portability means it can be moved with great effort, similar to the effort put into writing the original program.

portable—Refers to a piece of software that is easily moved from one type of system to another. If a product can be used on more than one platform or has built-in switching capabilities, it is considered portable. Also used as a noun to describe computer systems that are built with mobility in mind. See **portable computer**.



pop-up menu

portable computer—A PC designed to allow the user to take it on the road. While early portable computers were bulky and had very limited capabilities, today's models are thin, lightweight, and powerful. The most advanced portable computers have the same capabilities as the average desktop computer. The technology comes at a price, however, and to purchase a notebook computer with the same functionality as a desktop computer will usually cost much more money. See **laptop computer**. See **notebook computer**.

Portable Document Format (PDF)—A file format developed by Adobe that facilitates the conversion of graphics-heavy documents into a form that requires the free Acrobat Reader to read. Creating a PDF file, however, requires the full Acrobat program. PDF is especially useful for mass distributing documents, such as online brochures or software documentation. PDF documents retain their original layouts, so users see them as they were created. PDF files offer some benefits over converting brochures and other documents to Hypertext Markup Language (HTML); namely, it's easier to preserve the look of the document because users have more control over placement of graphics and can include copies of fonts in the document so that the file will look and print as intended. See **Hypertext Markup Language**.

portable language—A type of programming language used to create software for more than one type of computer system.

portal—A Web site that serves as a window to the rest of the World Wide Web. Its purpose is to guide surfers to just about anything they want to find online and provide as many services as possible in one place, such as free E-mail accounts, stock listings, and personalized news. Yahoo! and Excite are good examples of portals, but Web sites that serve as online guides to specific topics, such as Garden.com, also can be portals. See **horizontal portal**. See **vertical portal**.

port expander—A device that expands the number of peripheral units a user can connect to a single port, usually on a portable computer. An expander makes it possible to connect additional devices, but only one of those devices can operate at a time.

portrait mode—A vertical print orientation in which a document is printed across the shorter width of the paper. Most text documents, including the pages of Smart Computing, are printed in portrait mode. Compare to **landscape mode**.

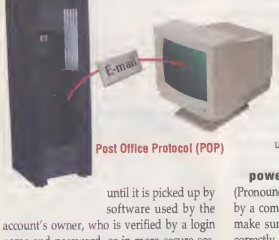
portrait monitor—A vertical computer monitor that is taller than it is wide. It is most often used with desktop publishing and graphics programs. The opposite type is the landscape monitor, which is wider than it is tall. Compare to **landscape monitor**.

POS—See **point-of-sale computing**.

post—A message or article published on an Internet newsgroup or other bulletin board area. Also means the act of publishing such a message or article.

POST—See **power on self test**.

Post Office Protocol (POP)—A format for storing and retrieving E-mail messages used by mail servers and clients. POP works with Simple Mail Transfer Protocol (SMTP), which enables E-mail messages to be sent from one system to another. Mail servers must run both protocols to be able to receive, send, and store messages. POP functions as a holding area for E-mail messages



Post Office Protocol (POP)

until it is picked up by software used by the account's owner, who is verified by a login name and password, or in more secure scenarios, a certificate. See **client**. See **mail server**. See **Simple Mail Transfer Protocol**.

posting—To transmit a message or article for publication on an Internet newsgroup or bulletin board.

postprocessor—A device or software that works with information that has already been processed.

PostScript—A page description language program created by Adobe Systems. Because of its great flexibility in type as well as graphics, PostScript has become the standard in desktop publishing. See **page description language**.

PostScript clone—A program that mimics the capabilities of Adobe Systems' PostScript page description language. While clones can cost considerably less than the real thing, most also offer fewer options and lesser quality. See **PostScript**.

PostScript font—A font found in the Adobe Systems' PostScript page description language. When a user has a PostScript printer, the computer automatically uses the PostScript font when printing, instead of the bit-mapped screen font that appears on the computer display. See **PostScript**.

POTS—Plain Old Telephone Service. See **analog phone line**.

power—The amount of computing ability, determined by speed and functionality, a computer has, or the actual electricity used to run a computer.

power down—To close down all active applications and shut off the power to the computer.

power failure—To lose electrical power to a computer system. Any data stored only in RAM and not on a permanent storage medium (such as a hard drive) may be lost during a power failure.

power on self test (POST)—(Pronounced post.) A set of tests performed by a computer during its startup routine to make sure all its components are working correctly.

PowerPC—The microprocessor architecture developed by IBM, Motorola, and Apple that was introduced in 1993. The first computer system based on the PowerPC architecture was Apple's Power Mac in 1994. The PowerPC is an alternative to the Intel-based architecture found in the majority of PCs. It can process 32 bits of data and has a 64-bit internal data bus. One of the early PowerPC chips, the 601, could run just as fast, if not faster, than an Intel Pentium. See **data bus**.

power strip—A device that acts like an extension cord, providing additional cord length, as well as a mechanism that offers several electrical outlets. Power strips are used in instances where there are not enough wall outlets to accommodate the number of devices that need to be plugged in. While some power strips offer surge-suppression capabilities, it is inaccurate to say

power strips and surge suppressors are the same thing.

power supply—The electrical supply needed to operate a computer. Also, the device inside a computer that transforms the AC electrical currents available in a standard wall socket into the lower DC voltages used by a computer.

power surge—An unexpected increase in the amount of voltage carried by an electrical line, usually caused by an oversupply at the source. A power surge can last for several seconds (unlike a spike, which occurs in a very short burst) and can severely damage an unprotected computer. Users can protect their computers from power surges with a device called a surge protector. See **spike**. See **surge protector**.

power up—To turn on a computer system.

power user—A user who is exceptionally knowledgeable and skilled in the use of computers and software.

ppm—See pages per minute.

PPP—See Point-To-Point Protocol.

Practical Extraction and Report Language (Perl)—A programming language used to process text. It is especially useful for developing computer graphics interface (CGI) scripts used on World Wide Web servers. It runs on many platforms (including Windows and Macintosh) and is already installed on most Unix workstations used as Web servers. In addition, it's available for free and allows developers to quickly write code. Perl also is frequently used to perform system administration tasks on Unix workstations. Compare to awk.

PRAM—See parameter RAM.

precompiler—See preprocessor.

pre-emptive multitasking—A type of multitasking where the operating system or computer may shift control from one program to another as it is needed. That way no single application can completely take over the processing power available. Each open application gets a "time slice" in which to work before the processor turns to another application. In this fashion, the various programs take turns with processing power, and if one application freezes up completely, the others will still be able to run. Compare to cooperative multitasking, in which the applications decide when to turn over the processor to each other. See multitasking.

preformatted—A computer diskette that is ready to accept data when the diskette comes out of the package. By contrast, users must format a completely blank diskette before using it for the first time.

prepress—The work done on a publication before it is sent for printing. For example, laying out the text and photographs for a newsletter on a sheet of paper.

preprocessor—A device or program that processes information before sending it on to the main program or processor. Also called a precompiler.

presentation graphics—A combination of colorful graphics used to present business information and other complicated data in easy-to-read charts and graphs in order to make immediate comprehension easier.

Presentation Manager—A graphical user interface for the IBM OS/2 operating system.

pressure-sensitive tablet—See touch pad.

preventive maintenance—The regular checkups and service performed on computer hardware to keep it working properly.

primary cache—See Level 1 caching.

primary channel—The channel used most often to transmit data through a communications device, such as a modem.

printer

primitive—In programming, basic objects or applications, as standardized parts, that can be pieced together to create more complex instructions. For example, the primitive binary code 0 can be added to a series of 0s and 1s to form a set of instructions. See binary.

print—To transmit data from a computer to a printer in order to create a hard copy.

print buffer—A temporary storage area that holds information waiting to print until the printer is ready to use it. A print buffer is often located in random-access memory (RAM) or in the printer's own memory. By holding the information and feeding it to the printer as needed, the print buffer allows the computer to continue with other work.

printed circuit board (PCB)—A plastic or fiberglass board that holds electronic circuits connected through metal pathways attached to the board. The motherboard is the main printed circuit board of a computer. Also called a PC board.

print head—The part of the printer that actually prints text and images on to paper. In an inkjet printer, the print head controls the firing of the different colors of ink, arranging them in a precise pattern on the paper's surface. In a dot matrix printer, the print head controls the pins that strike the printer's ribbon against the page. Laser printers don't have print heads; they use a method similar to a photocopier to create images on a page.

printer—A device that takes commands from a computer and produces hard copies, usually on paper, of the text and graphics that appear on the monitor. Printers such as the daisywheel and dot matrix produce images by striking the paper. Inkjet, thermal, and laser printers use more complicated and precise methods to render characters and images. These printers generally produce a higher-quality image than daisywheel and dot matrix printers.

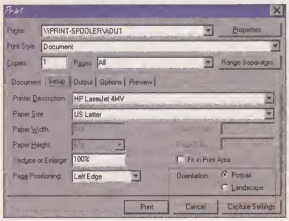
Printer Control Language (PCL)—A command language developed by Hewlett-Packard for its laser and inkjet printers. PCL is a common type of page description language (PDL). See page description language.

printer driver—A program that allows a PC to communicate with the printer. A printer driver will translate commands from the computer into instructions the printer understands. See device driver.

printer engine—The part of the printer that determines the resolution, speed, and overall quality of the printing. Most engines are replaceable self-contained units; printers from different manufacturers often use the same engine.

printer font—A font that exists specifically for use in printing. Most fonts appear differently on paper than they do on-screen. Compare to **screen font**.

printing orientation—The way a printer places an image or text across a page. The two types of printing orientation are portrait



printing orientation

mode (printing across the short width of the page) and landscape mode (printing across the length of the page). See **landscape mode**. See **portrait mode**.

print merge—See **mail merge**.

printout—The actual printed version of text or images. See **hard copy**.

print quality—The overall quality of a printer's output, based on resolution and clarity of the characters printed. A number of factors can affect print quality, including the type of printer and the mode setting of that printer. A laser printer should always have higher print quality than a dot matrix printer. On the dot matrix printer, however, the user may have three or more mode settings from which to choose. The draft setting will produce a lesser quality of print, but it saves time and materials. At the other end of the spectrum, at the presentation mode setting, the same printer will use more time, energy, and materials to produce a higher print quality. See **draft quality**. See **near-letter quality**. See **letter quality**.

Print Screen key—See **PRTSC key**.

print server—A computer that manages one or more printers on a local-area network. See **server**.

print spooler—A program that manages print jobs that have been sent to the printer. The printer does not print as quickly as a computer operates and often multiple users send documents to the same printer. These documents are sent to a spooler, where they wait their turn to print. This frees up the computer's attention so the user can continue working while waiting for a document to print. Also called spooling.

print wheel—See **daisywheel**.

priority—A degree of importance that determines when a task will be addressed by the CPU. Priority can be assigned to tasks within a single system or to entire computers on a whole network.

private key—The secret half of a two-part public key encryption system. The private key is kept secret and never transmitted over an open network. The private key is used to decode data that has been encrypted with a user's public key, which is available to everyone over a network. In this way, a person can send information encrypted with Bob's public key, safe in the knowledge that only the holder of Bob's private key will be able to read it. See **public key encryption**. See **public key**.

private line—See **leased line**.

privilege level—An authorized access level that each network user is assigned, either as a user, an administrator, or as a guest. This determines what information they can and cannot have access to.

privileged mode—An operating mode of the Intel 80286 and newer CPUs. In privileged mode, software can complete otherwise restricted operations that handle crucial components of the system. Some of these operations include manipulating memory and input/output channels.

PRN (PRiNter)—The name DOS assigns to the first parallel port, where most printers are connected to the computer. You may see this DOS term used if DOS ever gives you the error message, "Not ready writing device PRN." This means for some reason, the printer isn't ready to print.

procedural language—A type of programming language centering on the procedure or the order of the commands. Examples of this type of language include BASIC, FORTRAN, and Pascal.

process—To manipulate, alter, or display information contained in a computer. Regardless of which action is taken, the computer is processing. Process also can be used as a noun to refer to a computer program, a part of a program, or the series of steps taken by a program.

process color—A type of printing in which a computer takes a full-color image and re-creates it by mixing and blending the four colors it has available. Those four colors are cyan, magenta, yellow, and black. Compare to **spot color**.

process color

processing—The main job for which a computer is designed—to manipulate or process the data that it receives and to output the results.

processing capacity—The number of operations a microprocessor can perform in a set amount of time. See **capacity**.

processor—See **microprocessor**.

processor cache—See **RAM cache**.

program—A set of instructions that tells a computer what to do. Programs allow a computer to function and will generally

contain a list of variables that represent numbers, text, or graphics. A program also will have a series of statements that tell the computer what to do with these variables. Programmers use a variety of languages to create programs, but each must be translated into machine language before the computer can act on it. An example of a well-known program is Microsoft Word. Most program developers will continually update their programs with newer versions. Also called software.

program counter—A device within a computer that keeps track of the next instruction a program will require to continue its operation. Also called a current location counter.

program file—A file necessary for the start of a program's operation. The program file contains the executable portions of a program.

program generator—A program that produces other programs by following the parameters set down by the user. Program generators make the process of creating new applications less complicated and tedious but provide less flexibility than if a program were written by a human.

program group—In Windows 3.x, a type of window holding icons representing applications. The Program Manager holds icons that represent the various program groups, which can be opened with a double-click. The application icons held in the program groups then can be double-clicked to launch individual programs. Users can add, delete, rename, and reorganize program groups.

program information file (PIF)—(Pronounced piff.) A file used in the Microsoft Windows 3.x operating system that contains information used to run a DOS application in the Windows environment. A program information file will have the PIF file name extension attached to it.

program listing—A copy of a program's source code, usually reproduced on paper.

program logic—The basic instructions that determine how a program carries out the task it was designed to do.

programmable—The ability of a machine to follow instructions and carry out user-dictated jobs. Computers are programmable.

programmable function key—A keyboard key the user can program to execute an often-used multikey strike combination. A key programmed in this manner can help shorten a process by eliminating the need to repeatedly type in the key combination. The keys, sometimes unlabeled, may appear on third-party keyboards to perform just such tasks, without any special RAM-resident software.

programmable read-only memory—See programmable ROM.

program group

programmable ROM—A memory chip that allows data to be written to it once using a programmable ROM programmer. The chip stores the data permanently, even when the computer's power is turned off. As opposed to ROM, which is programmed by the manufacturer, PROM can be written to by a customer. See programmable ROM programmer.

programmable ROM programmer—A piece of hardware used to write to a programmable ROM (PROM) chip. Once this device has written to a PROM chip, the user cannot reprogram the chip. Also called a programmable ROM (PROM) Blaster. See programmable ROM.

Program Manager—The main window of Windows 3.x. The Program Manager holds icons representing program groups, which hold icons for applications. To close the Windows interface, a user closes the Program Manger like any other window by double-clicking the upper-left corner.

programmatic interface—See command-line interface.

programmer—A person who writes the codes that make up a program. Many programmers have degrees in computer science while many other programmers have trained themselves to program computers. A single programmer may write an entire program, or he or she may be part of a team of programmers and only write a portion of it. Another part of a programmer's duties is debugging the program and getting rid of any glitches the program may contain. On the hardware side, programmer also is the name for the device used to write data to programmable ROM.

programmer's switch—A plastic piece that comes with some models of the Apple Macintosh that when installed, allows the user access to two new switches: a reset switch that restarts the computer without shutting off the power and an interrupt switch. The interrupt switch returns the user to the desktop without resetting or restarting the computer.

programming—To design and write a computer program. During this process, a programmer decides which problem to solve, develops the logic to solve it, and writes the codes that will instruct the computer as to how that logic is to be applied. When writing these codes, the programmer must use a programming language that the computer can translate into a machine language it is able to understand and execute. Also called coding.

programming in logic (Prolog)—A logical programming language developed in France in the 1970s and used throughout the world today, specifically in the field of artificial intelligence.

programming language—A language that allows human programmers to communicate their instructions to a computer. Assemblers, compilers, and interpreters turn the programmer's language into the machine code a computer can understand. There are many types of programming languages, some designed for operating speed and others designed to be

more like natural human languages for ease of understanding. Some examples of programming languages include BASIC, Visual BASIC, COBOL, dBASE, and Java. Compare to **machine language**. See **assembler**. See **assembly language**. See **compiler**.

programming tools—The programming software used by programmers to help save time during the development and perfection of new programs. Programming tools can include a graphical user interface, editor, debugger, and compiler.

program statement—See **statement**.

progress indicator—A graphic, usually in the form of a horizontal bar, that shows how much of a particular process has been completed. Progress indicators are frequently seen in installation programs to show how much data the computer has copied from the installation diskette or CD-ROM to the hard drive.

progressive JPEG—A Joint Photographic Experts Group (JPEG) file that loads a piece at a time instead of all at once. The image first appears in its full size, but it is light and hazy. As the rest of the file downloads, the resolution gradually improves. Regular JPEGs, on the other hand, do not appear on-screen until the entire image has loaded, or they appear a few lines at a time. Web designers like to use progressive JPEGs because many Web users are still stuck with slow Internet connections. By loading JPEGs gradually, they can get the basic design and layout of the page on-screen more quickly. See **Joint Photographic Experts Group**.

project management software—Software used to keep track of the numerous tasks and details that go into a single large project. For example, to plan a wedding means contacting, interviewing, and hiring a number of different service providers. Project management software helps the user make sure each task is completed in a timely and accurate fashion, ensuring the entire project comes together in the end.

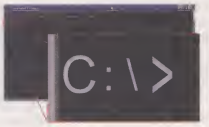
Prolog—See **programming in logic**.

PROM—See **programmable ROM**.

PROM blaster—See **programmable ROM programmer**.

PROM programmer—See **programmable ROM programmer**.

prompt—The symbol at which commands are typed by the user to make the system perform functions in a command-line inter-



prompt

face. In MS-DOS, the prompt usually appears as the current drive letter, such as C:, followed by a greater-than sign (>). In OS/2, the prompt format is slightly different; [C:\] would be the prompt for the C: drive. Also called a command prompt.

propagated error—The final error that occurs when one computer operation produces an error, and that error is included in the input for another operation, producing the propagated error.

propagation delay—The time between when a computer sends a signal and when it is received.

proportional spacing—A formatting technique where each letter occupies a different width based on the requirements of each individual character. For example, the letter *M* takes up more horizontal space than the letter *J*. Compare to **monospacing**.

proprietary software—Privately created, owned, and copyrighted software such as Microsoft's Windows 98. To legally use proprietary software, a user must purchase the software, or purchase the right to use copied software, from the manufacturer. Compare to **freeware**. See **public domain software**.

protected mode—An operating mode of Intel 80x86 processors. Protected mode allows the user to address extended memory. It provides the means for multitasking, virtual memory, and data security. In 80386 and newer microprocessors, protected mode also offers memory-management and memory-protection functions. Compare to **real mode**.

protection error—See **general protection fault**.

protection fault—See **general protection fault**.

protocol—A set of rules and procedures for exchanging data between computers on a network or through the Internet. Protocol usually includes information on error checking, data compression, and sending and receiving messages. Also called an access method.

prototype—The demonstration model of a new computer or program.

prototyping—To create a demonstration model of a new computer or software product that allows the creator to fix problems and make corrections before the system or software is produced on a larger scale.

proxy server—A server that acts as an intermediary between the Internet and users on a private network. The proxy server receives Web page requests from a user, fetches the page from the Internet, and then serves it to the computer that requested it. The process is transparent to the user, but by breaking the connection between that user's computer and the Internet, security is ensured. The proxy server prevents hackers from using the Internet to gain access to computers on a private network. Proxy servers are part of a firewall. See **firewall**.

PRTSC key—(Pronounced PRINT screen.) A keyboard key (on most standard keyboards) that, when pressed, sends the information displayed on-screen to the printer or to the Clipboard. The image then can be printed or pasted from the Clipboard into a graphics program for manipulation and printing later.

PS/2 bus—See **micro-channel architecture**.

PS/2 port—The de facto standard for all mouse and keyboard ports on IBM-compatible computers. The 6-pin port was originally developed by IBM for its PS/2 line of

PS/2 port

computers but was eventually adapted by other computer manufacturers. See port.

pseudocode (p-code)—A programming code created for a processor that doesn't exist in reality. The p-code must be run through an interpreter program before a computer can use it. The advantage to using a p-code is that any computer with the correct interpreter software can read it. Applications in such a system may run more slowly than those written in traditional programming languages, but the ability to run the same exact program on many types of computers is valuable on large networks, such as the Internet. The most famous p-code system is Java, which can be found on many World Wide Web pages. Interpreters to run Java applications on various computers are built into Web browsers. See Java.

pseudolanguage—A programming language that no computer can execute until it is translated into machine code.

pseudomachine (p-machine)—A computer or processor that doesn't physically exist, but is created and maintained through software.

pseudo-operation—A program operation that forwards instructions to a device that is translating computer code into machine code, but which is not actually compiled itself.

public carrier—A telecommunications service provider, such as AT&T, that the government regulates.

public domain software—Software that can be used by anyone; a private individual or company no longer owns it. Public domain software, however, still carries a copyright. Compare to freeware. See proprietary software.

public key—The public part of a two-part encryption system. Users can encrypt information using someone's public key with the knowledge that only the owner of the corresponding private key will be able to open it. Conversely, users can encrypt information with their private keys so that the only way to read it is to decode it with the commonly available public key. This way, other users know for sure who sent data because only the correct public key will decode the information. See private key. See public key encryption.

public key encryption—An asymmetric scheme that uses two keys for encryption, a public key and a private key. The public key encrypts the data while the private key decrypts it. In public key encryption, each person gets a pair of these keys. Each person's public key may be published and therefore known by everyone, but the private key is kept private, exclusive to the holder. Messages are then encrypted using the recipient's public key and thus can only be decrypted by the recipient's private key. For example, if Paul wants to send a secret message to George, he would use George's public key to encrypt it. George then uses his private key to unlock the message. Public key encryption programs are secure and fairly easy to use. Pretty Good Privacy (PGP) is an example of this type of program. See private key. See public key.

puck—An input device similar to a mouse, but used specifically with graphics programs. A puck usually has a set of cross hairs built into the unit that provides the user with greater precision on a graphics tablet.

pull-down menu—A menu in a graphical user interface that is opened by placing the screen cursor over the title and clicking a mouse button. A list appears below the title, and the user can select options from that list.

pulse—A fast, distinct signal. Pulses are used in electrical systems such as computers. For instance, your PC's clock gives out pulses to keep the whole system synchronized. Pulses are also often used when sending signals digitally over communications lines. See clock pulse.

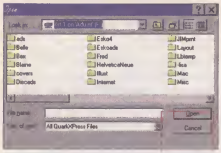
pulse code modulation (PCM)—A method for digitizing analog signals, especially audio signals. PCM applications sample sounds 8,000 times per second and use 8 bits to store each sample. PCM is used in high-speed 56 kilobits per second (Kbps) modems, as well as Internet backbone connections, such as T1 and T3 lines. See analog. See T1. See T3.

punched card—A medium used as data storage and entry devices in "computing" systems as early as the late 1800s and until as late as 25 years ago. The holes in the card corresponded to letters, numbers, and other characters, and they could be read by a computer with a punched-card reader. The cards were originally punched by hand, but in later stages had 80 columns of machine-punched holes. The system is believed to have been inspired by the Jacquard weaving loom, a fully automated loom programmed by punched cards.

punched card reader—The device used to read computer data from punch cards, an early method of storing and entering data.

purge—To eliminate unneeded information from a system. Users may purge old files from their computer for more storage space. For example, a student may decide to purge all the document files associated with a history class after the class has been completed.

push—To send information over a network to a computer without a computer request. Most information is "pulled" from networks such as the Internet by users who see information and request it by a hyperlink, for example. With push technology, the user subscribes to an information delivery service such as PointCast, which then pushes the desired information to the user on an agreed-upon schedule. Microsoft Internet Explorer 4.x makes substantial use of channels through which information from major media content providers is pushed. The method by which a periodic E-mail message is sent to a subscriber from, for example, an online publisher or company, can also be classified as a push technology.



push-button

push-button—A button located in a dialog box that a user pushes by placing the cursor on it and pressing ENTER or clicking the input device.

Q

QBE—See **query by example**.

QIC—See **quarter-inch cartridge**.

quantum—A tiny amount of time or energy in physics. In terms of computers, quantum systems would theoretically be dizzyingly faster than today's computers because they could factor numbers much more quickly.

quarter-inch cartridge (QIC)—A format of magnetic data storage tape used to create backup files. The storage capacities of QICs range from 40MB to more than 13GB.

quartz crystal—A small piece of quartz, formed to exact size and shape, that vibrates at a defined frequency when electricity is applied to it. It is used to regulate time in watches and the operation of PCs.

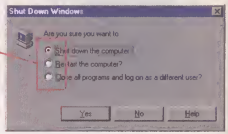
query—To request information from a database during database processing.

query by example (QBE)—To request information from a database by providing words or phrases in the fields of the database where the user would like to find them. The user types data into the fields of a database form. The computer then attempts to find records that are most like the example just created by the user. Compare to **structured query language**.

queue—(Pronounced cue.) Operations such as printing that are being held, usually in the order received, before the computer executes them. Also refers to lining up these operations. When referring to programming, it means to remove data elements in the order they were entered.

queue management system—A system, such as a print manager, that sorts different operations and executes them by predetermined priority.

radio button



QuickTime—A type of video and sound playback format for computers developed by Apple Computer. Apple includes QuickTime software with the Macintosh operating system and also offers a version for PC users. The use of QuickTime has become so widespread that it has become a video standard. QuickTime plays back video and sound in other applications that use QuickTime without any help from the user.

quit—To end a session with a program by purposely closing the application.

QWERTY keyboard—(Pronounced KWERty.) Invented by Christopher Sholes (who invented the typewriter in 1868), this keyboard takes its name from the arrangement of the six top-left keys. The QWERTY standard is by far the most common keyboard in use, although the Dvorak keyboard design is theoretically more efficient. Compare to **Dvorak keyboard**.

R

radiation—The emission of energy as radio waves or particles. Radiation is absorbed by the body, sometimes causing physical problems ranging from headaches to cancer. All monitors emit radiation, but color monitors send out more than monochrome monitors. Experts disagree about whether the radiation from a computer is a significant health risk. The amount of radiation that is absorbed from a computer, however, is less than what an average user is exposed to by household appliances such as radios and hair dryers. Monitor manufacturers are working to lower the emissions even further. To reduce the amount of radiation you're exposed to, avoid sitting closer than an arm's length to the monitor and consider using a filter on it as well.

radio button—A circle that represents choices in a common option list form in graphical user interfaces. Only one item in a list with radio buttons can be selected at a time. To select an item in such a list, the user clicks the radio button in front of the desired option, and a dot appears in the circle of the radio button to show the option has been selected. The name radio button comes from the fact that these buttons are similar to those on a radio; choosing one automatically undoes the previous choice.

radio frequency (RF)—The range of frequencies from 10 kilohertz to 3,000 gigahertz on the electromagnetic spectrum between light and sound. These frequencies are used by devices such as AM and FM radios, baby monitors, or for communications between satellites.

radio frequency shielding (RF shielding)—The material designed to keep radio frequency (RF) electromagnetic radiation confined inside or sealed out of a device. The material is usually metal or metallic foil. A computer has a metal casing over its circuit boards to prevent radiation from leaving the system, often built into the case. The Federal Communications Commission has standards to keep equipment from passing on radio frequency signals and interfering with other equipment.

radix—The base value of a number system. For example, in the decimal (base 10) system, the radix is 10 while in the binary system (base 2) the radix is two.

radix point—The separator between the integer part of a number and the fractional part. For example, the decimal point between 2.5 is a radix point.

rag—To format a page leaving lines of text uneven along the side of a page. Generally, the left side of text is justified, and the right is ragged. Compare to **justify**.

ragged—See rag.

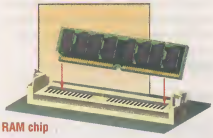
ragged left/right—A term that explains which side of a body of text is ragged. Ragged left means the left side is ragged while the right is even; ragged right is the opposite. See rag.

RAID—See redundant array of inexpensive disks.

RAM—See random-access memory.

Rambus Dynamic random-access memory (RDRAM)—A memory standard that will probably be the successor to the present memory standard, Synchronous Dynamic RAM (SDRAM). RDRAM, which runs at speeds of 600 megahertz (MHz) to 800MHz, is much faster than present memory, which clocks at 100MHz to 125MHz (SDRAM) or 200MHz (SDRAM II). RDRAM chips have been incorporated into some console game systems, such as the Nintendo 64, as well as video cards and add-in cards from Creative Labs. They have not, however, been used as main memory in personal computers. It will take some time for computer manufacturers to incorporate RDRAM memory chips (called RIMMs—Rambus In-Line Memory Modules) into their computers. Two types of RDRAM, concurrent and direct, are in development. Concurrent is based on standard RDRAM and is the type currently deployed in console games and add-in cards. Direct RDRAM has more enhancements and runs faster than concurrent RDRAM. RDRAM chips require less voltage than conventional memory, and a single chip can supply up to 128 megabytes (MB) of memory. Compare to **dynamic random-access memory**. Compare to **Synchronous Dynamic random-access memory**. Compare to **SyncLink Dynamic random-access memory**.

RAM cache—A cache made of high-speed static RAM (SRAM) linked directly to the CPU. RAM caches are used for keeping a copy of the most recently and most frequently accessed data in memory so the information is more quickly accessible. Also called a memory cache or processor cache.



RAM chip

RAM card—An add-in board used to add RAM to a system. RAM cards are inserted into slots on the motherboard. Single in-line memory modules (SIMMs) are RAM cards.

RAM cartridge—See memory cartridge.

RAM chip—A chip that contains RAM storage. See **dynamic RAM**. See **static RAM**.

RAMDAC—See **RAM digital-to-analog converter**.

RAM digital-to-analog converter (RAMDAC)—(Pronounced RAM dack.) A video adapter chip that maintains the color palette and changes digital data from memory into anavblog signals for display on the monitor. A RAMDAC chip typically enhances overall video appearance and performance.

RAM disk—A simulated disk drive, or a part of memory that acts as a logical disk drive, whose contents are actually stored in RAM memory. A RAM disk is very fast because an electronic rather than a physical storage device is accessed, thus creating less work and increasing speed. A RAM disk can be used to copy files more quickly. For example, if there are several copies of the same set of files to be made, those files can be copied to the RAM disk and then to diskettes. Similarly, a program that runs slowly can be copied from the hard drive to the RAM disk, and it will run faster. The RAM disk can be used for anything a physical disk drive would be used for, such as running programs. There are a few disadvantages, though. First, system memory is given up in order to create a RAM disk, and, second, the contents of a RAM disk usually are lost when the computer is turned off. Also called a RAM drive or virtual disk.

RAM drive—See RAM disk.

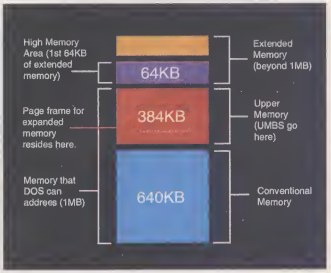
RAM refresh—See refresh.

RAM-resident program—See **terminate-and-stay-resident program**.

random-access—See direct access.

random-access file—A file whose records can be accessed in any order, instead of sequentially. You can access files on a hard drive or diskette randomly because the head can glide over the platter directly to the location of the file. Tape drives must spin through the tape sequentially to reach the file you need, taking a lot longer to access. That's why hard drives and diskettes are better for quickly obtaining files, and tape drives are better for backup.

random-access memory (RAM)—(Pronounced ram.) The standard type of



random-access memory (the organization of the first megabyte of memory is crucial to how well DOS programs run)

memory that is read from and written to by the CPU and hardware. Information in RAM can be stored and accessed randomly, and therefore, more rapidly. RAM, which is also called main memory, is the vital workspace of computing. The more RAM a system contains, the more information it can handle and the more programs it can run at one time. Note, however, that in DOS, a large amount of RAM doesn't guarantee that a program will run. DOS programs may not run if the rather limited conventional memory portion of RAM is filled with data. Memory-management techniques are used to store some information in other parts of RAM, such as upper memory. Extra RAM can be added to a system in the form of small boards called single in-line memory modules (SIMMs) or dual in-line memory modules (DIMMs). Compare to **read-only memory**. See **memory management**. See **single in-line memory module**. See **dual in-line memory module**.

range—A selection of cells in a spreadsheet that is manipulated as a group. The group can consist of a row, a column, or a block made up of both. The selected cells must be adjacent to one another. Also called span. Range can also refer to the spread between low and high values in a set of data.

RAS—See **remote access service**. See row **address strobe**.

raster—Lines on the inside of the screen traced by an electron beam to create an image called horizontal scan lines. These lines appear on a monitor or TV screen.

raster display—A monitor or TV that presents on-screen images line by line.

raster font—See bit-mapped font.

raster graphics—A digital method for creating a picture image using a complex series of dots. Compare to **object-oriented graphics**. See **bit-mapped graphics**.

raster image processor (RIP)—A device that transforms a vector image into a bit-mapped or raster image, usually in preparation for printing.

rasterization—Converting object-oriented graphics to raster (bit-mapped) graphics, using a raster image processor (RIP). Vector graphics are collections of lines, but monitors and printers handle images as sets of dots, so images must be rasterized before they can be displayed on a monitor or printed. Depending upon the resolution of the printer or monitor, a rasterized image may have lower quality due to the grainy appearance of the dots at some resolutions.

rasterize—See rasterization.

raster-scan display—See raster display.

raw data—Information that has been gathered but not processed.

RCA connector—A connector used to connect audio and video devices to some video adapters and sound cards. The name comes from the common Radio Corporation of America (RCA) speaker connector. A more generic term is phono plugs or phono jacks.

RDBMS—See **relational database management system**.

RDRAM—See **Rambus Dynamic random-access memory**.

read—The way a computer receives information; to input information from a peripheral device into a computer. Read typically refers to reading data from a disk drive, although the source may also be the keyboard. It is the opposite of write, which is to transfer information to storage or to the printer or screen. Every transfer of data, whether it is peripheral or internal, is a read from somewhere and a write to somewhere else. Compare to **write**.

reader—See **magnetic card reader**. See **punched card reader**.

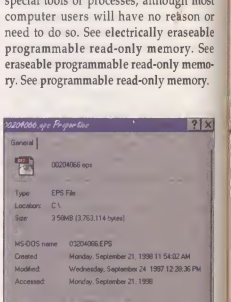
read error—A failure by either a computer or its source while in the process of inputting information into the computer.

README file—A text file containing information for the user. Often, README files are included with software to give the user information that wasn't included in a program's printed documentation.

read-only—Stored data that can be accessed but not altered. Usually, this term refers to information that can't be physically altered. For example, traditional CD-ROMs are created by a method of creating pits in the storage medium. Users usually can read, but not change, the information stored in this way. Read-only also may refer to the status of a file. For example, files can be placed in read-only status for security purposes. This status is used for documents such as newsletters that are available to all users on a corporate network.

read-only access—A type of access privilege that permits the reader to view a file but not alter it. For example, users on a network may be granted read-only access to files in a company database so they can't change the information without permission to do so. Also called read-only permission.

read-only memory (ROM)—(Pronounced rom.) A type of built-in semiconductor-based memory that can only be read and not altered in any way. Unlike RAM, which is cleared of data when the computer is turned off, ROM is able to retain the contents of its memory through the help of a long-life battery inside the computer. ROM stores the information that allows the CPU to boot up when it is turned on. There are some types of ROM that are eraseable and programmable with special tools or processes, although most computer users will have no reason or need to do so. See **electrically eraseable programmable read-only memory**. See **eraseable programmable read-only memory**. See **programmable read-only memory**.



read-only

read-only memory Basic Input/Output System (ROM-BIOS)—See **Basic Input/Output System**.

read-only permission—See **read-only access**.

read-only terminal (RO terminal)—A device that can accept data but cannot form it itself. Also called receive-only terminal.

read/write (R/W)—Having the capabilities to both be read from and written to. A hard drive is an example of a device that can be read from (for example, when you access a document file stored on the disk) and written to (such as when you save new or modified files to the disk). Compare to **read-only**.

read/write channel—See **input/output channel**.

read/write head—See **head**.

read/write memory—See **random-access memory**.

read/write permission—An access privilege that lets a user read and write to a file. Compare to **read-only access**.

real address—See **direct address**.

real-address mode—See **real mode**.

real mode—An operating mode of Intel's 80x86 processors. In real mode, the processor takes on the attributes of a lower 8086 or 8088 processor in order to run programs specific to those processors. The only DOS-supported operating mode, real mode limits the processor to 1MB of memory. It does not have memory-management or memory-protection features. Compare to **protected mode**.

real storage—See **physical memory**.

real-time—Refers to a computer-related operation that occurs within a time frame imposed by external conditions. Real-time operations either happen in a human's perception of the normal passage of time, or proceed at the same speed as a physical or external process. For example, a real-time operation consistent with human perception of time would be the communication that occurs in an online chat room, provided those communications occur quickly enough to be perceived as conversation rather than E-mail.

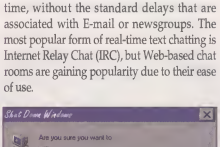
real-time animation—A method of computer animation where screen images are updated at the same speed at which the simulated objects might move in the real world. Movement dictated by a player in arcade-type games makes use of real-time animation; the action and speed are controlled by the user and the computer keeps up with the choices made as they occur.

real-time clock—See **clock**.

real-time operating system—An operating system designed to handle events as they happen (one in which prompt feedback is important). For example, a real-time operating system is needed for quick response in air-traffic control or in ship navigation, when a response is needed as events occur.

real-time system—A computer or software system that deals with real-life actions before those actions become obsolete. Air-traffic control systems, for example, process information regarding air safety and must relay that information quickly enough to give the pilots time to react.

real-time text chatting—Conversations over the Internet that take place in normal time, without the standard delays that are associated with E-mail or newsgroups. The most popular form of real-time text chatting is Internet Relay Chat (IRC), but Web-based chat rooms are gaining popularity due to their ease of use.



reboot

reboot—To restart the computer and reload the operating system. Many types of computers reboot when the key combination CTRL-ALT-DEL is pressed. In Windows 95 and Windows 98, rebooting can also be done by selecting Shut Down from the Start menu, then clicking Restart The Computer. Rebooting is sometimes the only way to regain control over a computer that is frozen due to error. Rebooting a computer, however, causes all unsaved data in open applications to be lost. See **boot**. See **warm boot**.

receive data (RXD)—The physical line that transmits received data from one source to another, often from a modem to a computer. Compare to **transmit data**.

receive-only terminal (RO terminal)—See **read-only terminal**.

record—A collection of related pieces of information. For instance, a career center at a college might keep a database of all the students it has placed in internships. Each record in the database would contain all the information about one student. If there are 300 students in the career center's internship placement program, there would be 300 records. Each record in turn contains fields for name, address, year in school, grade point average, and other criteria. See **record layout**.

record head—A device that writes data on a tape. In some tape drives and all disk drives, the record head is combined with the read head. See **head**.

record layout—The way data fields in a record are arranged. For example, an office supply business might keep a database of its regular customers and the types and brands of supplies they order. Each record in the database would be about one customer. Within the record would be fields for such information as name, address, billing procedure, and product preferences. Record layout determines how these fields would be arranged within the record (that is, name and address fields at the top of the record, billing procedure code at the bottom of the record). See **record**.

record length—How much space a record takes up, measured in bytes. Also called record size.

record locking—A way to keep more than one person from changing information in a record at one time. The first user to access the record automatically locks others out.

record number—A way of organizing records. Each record is given a number in sequence, which can change with the addition or removal of subsequent records.

record size—See record length.

recover—To stabilize a PC after an error has occurred. If used in conjunction with a program, to recover means the program stabilizes itself and returns to use without user intervention. Often "recover" is used to describe getting files back after a hard drive error. In this case, a recovery program searches for whatever information remains in storage. Whatever is found is "recovered."

recoverable error—An error that doesn't cause system failure. For example, if a user enters incorrect information, or information in an unacceptable format, this is an error, but it wouldn't cause the system to crash. Instead, the user probably would be prompted to enter the information again in a correct format.

recovery—A return to normal operating conditions after an error has occurred. Recovery may involve complex retrieval of information lost due to system errors.

recovery time—The length of time it takes to return a system to normal operation after an error.

red book—A set of specifications for mass-market audio compact discs. See compact disc.

red-green-blue (RGB)—The creation of color on a monitor through the precise combining of the red, green, and blue colors through separate signals. Compare to cyan-magenta-yellow.

red-green-blue monitor (RGB monitor)—A monitor that uses the red-green-blue method of color creation by precisely combining these three colors. A TV monitor, on the other hand, receives a single electrical signal, called composite video, which combines all the necessary visual information together.

redirection—To send input or output through a device other than the one usually used for that operation. For example, output can be redirected so a saved file goes to the A: drive instead of the C: drive.

redlining—A way of signifying that certain text has been edited. Redlined text isn't necessarily marked in red; it can appear in any color, or in bold, so long as it stands out from the other text. This technique is used to distinguish text added or changed by one user in a document that is being worked on by two or more people. For instance, Microsoft Word's Revision mode lets one or more people make editing suggestions to a file. The changes made can be shown on-screen and/or on the hard copy, with a particular color used for each person.

redlining

radio button—
A round circle representing choices in a common option list form as graphical user interfaces. Only one item as a list with radio buttons can be selected at a time. To select an item as such a list, the user clicks on the radio button in front of the desired option, and a dot appears at the centre of the radio button to show that the option has been selected. The name radio button comes from the fact that these buttons are similar to those on a radio: choosing one automatically undoes the previous choice. [illegible]

reduced instruction set computing (RISC)—A microprocessor architecture that processes a small set of instructions rapidly. RISC chips carry out simple instructions faster than complex instruction set computing (CISC) chips, but are slower to carry out complex instructions. PowerPC chips are true RISC microprocessors. Intel Pentium chips are CISC microprocessors; however, Pentium II and Pentium III processors include more RISC-like properties. Compare to complex instruction set computing.

redundancy check—See cyclic redundancy check.

redundant array of inexpensive disks (RAID)—Technology that allows a user to simultaneously use more than one hard drive to create backup copies of certain data or applications.

reformat—To alter a document or to erase all information on a diskette or hard drive. In the case of a diskette, reformatting usually is done to prepare it for reuse.

refresh—Commonly associated with computer monitors or portable computer displays, refresh refers to the renewal of screen content. The higher a monitor's refresh rate, the better the image quality. Also can mean the recharging of dynamic random-access memory chips (DRAMs) so they maintain the data they're storing. This process is known as RAM refresh. See dynamic RAM.

refresh cycle—The process in which dynamic RAM (DRAM) controllers provide repeated electrical pulses to the memory chips. The refresh cycle, which occurs with each pulse, renews the electric charges that represent a binary 1. DRAM loses any stored information if it is not constantly refreshed. See dynamic RAM.

refresh rate—The number of times per second that a computer screen image is renewed. A fast refresh rate makes a screen easier to view. Good monitors have a refresh rate of 70 hertz (Hz) to 75Hz or faster. See hertz.

refurbished—Previously owned computers that have been tested, repaired (if necessary), and repackaged by computer retailers or manufacturers. Refurbished computers are typically much cheaper than a comparable new computer. Similar discounts are available on refurbished peripherals, such as printers and removable drives. Most computers and peripherals have at least a 1-year warranty, but some refurbished equipment has only a 90-day warranty. Refurbished equipment is a good deal for the cost-conscious and lets computer companies cut their losses on returned items. Availability of refurbished items often is limited, however, so in some cases it may be quicker to buy a new computer instead of waiting for a refurbished one.

regeneration buffer—See video buffer.

region fill—In a paint program, the act of filling in an area with a specific color or pattern.

register—A high-speed data-storage area the microprocessor uses to process information. Registers usually are 16, 32, or 64 bits wide.

register capacity—The number of bits or bytes a register can store.

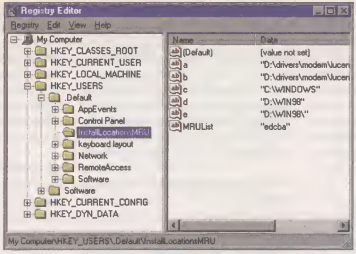
registered user—The person who purchased a software package and registered it with the company, usually by sending information via postcard or online. Registered users often are entitled to extra benefits, such as free technical support, information, and updates that nonregistered users do not receive.

registration—To register software with the manufacturer, which makes the user eligible to receive benefits, such as free technical support and product updates. Registering software usually involves sending in information on a registration card or via E-mail. It also can mean aligning the layers of an image or document in the correct fashion, so nothing appears out of focus.

registration card—A card included with commercial software so the purchaser may register the copy, entitling the user to benefits, such as free technical support.

registration marks—Marks on a page that help ensure all elements are aligned properly.

Registry—A database that contains information about user preferences and system configuration in Windows 95, Windows 98, and Windows NT. The Registry contains information about which devices are attached to the computer and which drivers should be used with them. It also keeps track of file associations (which programs should be used to open which type of files) and user preferences, such as what the monitor resolution and Desktop pattern should be. The Registry is contained in the System data and User.data files. Changes to the Registry are generally made through the Control Panel, not by users directly editing the Registry. To manually edit the Registry, the Regedit utility can be used. Extreme caution is advised when manually editing the Registry because errors in it can disable Windows and prevent the machine from booting. See device driver.



Registry

relational database—A database that can share information across multiple tables or files. These tables can be linked, or related, by common information. Relationships include one-to-one, one-to-many, and many-to-many. For example, one file may store the names of students and another file would contain their classes—a one-to-many relationship. A major strength of relational databases is that the same information can exist in multiple files simultaneously. When records are changed in one part of the database, the information is updated wherever else it occurs. These databases also use a feature known as lookups, which copy information to only one location. This is useful in cases such as invoicing, where a changed product price would be reflected in new invoices while the price in old invoices would remain unchanged. Compare to flat file.

relational database management system (RDBMS)—A program that lets a user create relational databases and work with them. See database. See relational database.

relational database structure—See database. See relational database.

relational model—See relational database.

TABLE 1					
Employee #	**Store #**	**Last Name**	**First Name**	**Address**	**Phone #**
1894	11	Smith	Jane	114 Marington Way	555-1213
1895	4	Huggins	Elizabeth	233 Apple St., #7	555-7879
1896	67	Johnson	Samuel	47 B St., #5	555-2994
1897	67	Baxter	John	3254 Oliver Ave.	555-1213

TABLE 2		
Employee #	**Salary**	**Date Hired**
1894	42,600	5/09/90
1895	24,800	6/22/86
1896	28,000	11/28/96
1897	57,000	3/19/97

Relational databases are able to access information from more than one table of data at once, as long as those tables share a similar field. For example, a relational database could use the employee number field in the two tables shown to answer the question: "How many employees in store 67 make more than $50,000 per year?"

relational structure—The way in which the records of a relational database are organized. See database. See relational database.

relative address—See indirect address.

relative cell reference—A cell identification based upon how it is located relative to a predetermined starting point on a spreadsheet. For example, a calculation that adds the data contained in cell (X, Y) to the data contained in the cell (X + 2, Y + 3) uses relative cell reference. Compare to absolute cell reference.

relative coordinates—Locations defined by their distance from a given point.

relative pointing device—An instrument, such as a mouse, that lets the user control the on-screen cursor.

release—A specific version of a piece of software. The word release is often used in place of the word "version" when naming products. Release also may be used as a verb. When an application lets go of a portion of memory, or control of another resource, it is "releasing" it.

remailer—A service that sends E-mail messages through several sources, thus obscuring the address of the sender and making pathways untraceable.

remark—See REM statement.

R

remarking—An unscrupulous practice that deceives buyers about the true speed of a computer. When a computer is remarked, it has been overclocked and then advertised as running at the overclocked speed, not the true supported speed of the computer. Overclocking also leads to poor system reliability and a higher incidence of hardware failure, meaning those who sell remarked computers are not only lying about the computer's speed but also are selling unreliable computers. See overclocking.

remote—A device that is linked to another device via communications lines although the two may not be in the same room or even the same building. See communications line.

remote access—The hookup of a remote computer or other remote device.

remote access service (RAS)—A service that Windows NT provides, which allows you to retrieve documents from a remote computer via modem. This service acts like an E-mail service, complete with dial-up features and logon procedures, but it is much slower.

remote communications—When two devices transfer data via communications lines. See communications line. See remote.

remote control software—A type of program that lets a user access a computer system from a distant location using a modem or network so work can be done on the system. For example, a worker might access an office computer from home using a modem. Remote control software often lets the remote user be in complete control of the other system; files can be manipulated and applications can be executed. Often a password or other protection scheme ensures that only approved users can gain control of host systems. A remote control system is not a network; in a network, users share resources, but one computer doesn't control another completely in this fashion. Compare to network.

remote procedure call (RPC)—A piece of program code that forwards commands or data to a program running on a remote computer for processing. The remote program then passes the results back to the program that issued the RPC.

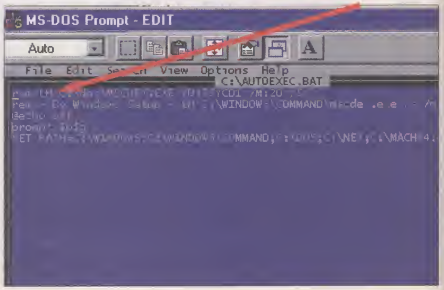
remote terminal—A terminal connected to a host computer but located in a place other than where the host computer is housed. Remote terminals communicate with their computer through various types of communication lines. See dumb terminal.

removable diskette—A storage device that can easily be moved from one system to another. A 3.5-inch diskette is the most common variety of removable diskette. See diskette.

removable hard drive—A hard drive in a plastic or metal cartridge that can be used and removed in a manner similar to a diskette. A major benefit of this type of hard drive is that it can be moved from one computer to another if both machines have a bay to accommodate the removable hard drive. This lets large applications and documents be moved from one location to another.

removable media—See removable diskette.

REM statement—(Pronounced remm.) An abbreviation for remark. A statement in a program or batch file, such as Autoexec .bat, that contains comments for the user, not instructions for the computer. These statements, which begin with REM, are ignored by the computer. REM can be added to the beginning of a line in a file to



temporarily disable the line because the computer will treat it as a remark instead of a command. The REM statement is often used when checking for errors in a system startup file. Files can be "REMmed" out as the user tries to isolate which line in a start-up file may be causing errors. To re-enable the line, remove REM from the beginning of the line. See **comment**.

render—See rendering.

rendering—To apply color, shading, and shadows to a computerized image to make it more realistic in appearance. For example, an outline drawing might be converted to an image with color and depth.

repaginate—When a document's page breaks are set again. When a document is modified, repagination occurs automatically on many programs. For example, word processors insert page breaks after a set number of lines, so that appropriate margins are around the text on each page. If a paragraph is added to the first page, the document will be repaginated to adjust to the new length.

repeat counter—A device that keeps track of the number of times a process has been carried out or is supposed to be carried out. Counters can be used for any repetitive process.

repeater—An instrument that increases a signal's strength so it can be transmitted and received over a greater distance without a loss in quality.

repetitive strain injuries (RSIs)—See **cumulative trauma disorder**.

replace—To exchange one item with another, specifically data. Many applications can be instructed to search for any occurrence of a certain string and replace it with another string. See **search and replace**.

report—A file, often printed, containing data from a database filtered and arranged in a way specified by the user. For instance, someone might produce a report listing only first names and birthdays from a contacts database containing many more data fields about a group of people. See **data**. See **database**.

report generator—An application that lays out and prints the contents of a database according to a user-specified format. See **report**.

repository—A computer system's background information, usually stored on the system itself. See **catalog**. See **data dictionary**.

request to send (RTS)—Communication between two devices in which one asks if it is all right to start transmitting data.

reserved character—A character reserved for a special purpose which cannot be used in naming files, documents, or macros. For example, the backslash (\) cannot be used in file names in DOS because of its function in designating file structure.

reserved word—A word that is reserved for special use in programs and cannot be used for naming files, documents, or macros. Reserved words in certain applications might include operators such as IF, OR, and NOT.

reset button—A button, usually found on the front of the computer case, that lets a user restart the computer without shutting off power to the computer. This generally is done when the computer has locked up, and the user can do nothing except reboot. Using a reset button is easier on a computer than shutting off the power to the system. See **reboot**.

resident font—See internal font.

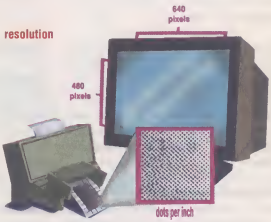
resident program—See **terminate-and-stay-resident program**.

resistor—An electrical component that provides resistance to a flow of electrons. Used in electrical circuitry for protection and to control a current.

resize—To change the size of a graphical element. Often refers specifically to changing the size of a window in a graphical user interface.

resolution—The amount of definition and clarity in an image on a monitor or from a printer. In monitors, resolution is measured by the number of pixels per square inch the device can display. In printers, resolution is measured in dots per square inch (dpi) that can be printed on paper. Generally a user can dictate the number of pixels per inch on a monitor, up to its capacity, by changing the display standards. In Windows, this

resolution



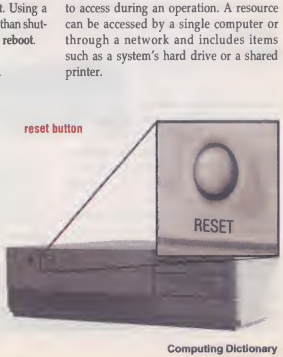
capability is found in the Control Panel. See **dots per inch**. See **pixel**.

resolution enhancement—A way to increase and improve a printer's resolution. Typically, resolution enhancement is accomplished by altering the number of dots per square inch (dpi) that are printed.

resource—An item, either hardware or software, that is available for a computer to access during an operation. A resource can be accessed by a single computer or through a network and includes items such as a system's hard drive or a shared printer.

R

reset button



response time—Elapsed time between a request for information and the return of that information or notice that it could not be found. This can mean the time between when a user enters a command and the computer carries it out or the time it takes a memory circuit or storage device to return information to the central processing unit (CPU). Also called turnaround time.

restart—See reboot.

restore—Returning a graphical interface window to its original configuration. Restore also can mean to recover information that had been lost or erased due to an operator or program error, or to return files from a backup copy to the hard drive where they originally resided. See backup. See **undelete**. See recover.

restricted function—A computer function or operation that can only take place under certain circumstances, such as the central processing unit (CPU) running in a particular mode. See **privileged mode**.

result set—The information produced as the result of an operation, specifically in databases.

result table—See result set.

retrieve—To find a piece of data and bring it to an active application. Information can be retrieved from memory or a storage medium, such as a diskette.

R

RETURN key—See ENTER key.

reverse address resolution protocol (RARP)—A Transmission Control Protocol/Internet Protocol (TCP/IP) sent from physical hardware locations to networks, which then process the request and reply with the Internet Protocol (IP) addresses that correlate with the server. Compare to **Address Resolution Protocol**. See **Transmission Control Protocol/Internet Protocol**.

ribbon cable

reverse stroke—See backslash.

reverse video—A display in which the usual color scheme of text and background has been switched to place emphasis on certain characters or sections of text.

revert—Calls up the version of a document that was previously saved.

rewrite—A do over; in documents, this means to reword or edit sentences, paragraphs, and pages. In data storage, rewrite means to save over a file with the same file.

RF—See radio frequency.

RF shielding—See radio frequency shielding.

RGB—See red-green-blue.

RGB display—See red-green-blue monitor.

RGB monitor—See red-green-blue monitor.

ribbon cable—A thin cable that looks like a strip of duct tape, with wires placed side by side. These cables are the type used inside a computer to attach built-in drives and other components to the motherboard.

ribbon cartridge—Nearly obsolete cartridges used in impact printers that contain the printer's ink-laden ribbon. See **impact printer**.

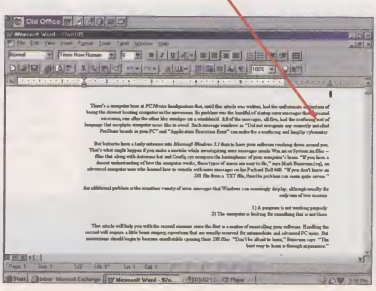
rich-text format (RTF)—A cross-platform, cross-application text document format. Rich-text format includes some, but not all, of the formatting information (such as bold and italics) included in many word processor-created documents. Therefore, a document saved in RTF may look a bit different when it is next viewed.

right justify—A page formatting that aligns text along the right side of the page. This layout has a ragged left edge and a straight right edge. Compare to **left justify**.

rigid disk—See hard disk.

ring network—See ring topology.

ring sequence—The order in which devices are connected to a token-ring network. Devices on such a network are connected to each other in the form of a circle or ring. See **token-ring network**.



ring status—The status of a computer attached to a token-ring network. Specifically, ring status refers to whether a station is attached to a multistation access unit (MSAU), which connects clusters of computers together in the ring. See **token-ring network**.

ring topology—A network topology that takes the shape of a circle. Each computer in the network, or node, is connected to the next with small sections of cable. Messages sent from one node travel around the ring until they reach the

right node, moving in one direction only. Also called a ring network. Compare to **bus topology**. Compare to star topology.

RIP—See **raster image processor**.

ripper—A program that extracts digital audio from an audio CD and stores it as a digital sound file (usually a WAV file). The audio "ripped" from the CD then can be copied on to a blank CD or converted to an MP3 file. See **digital audio extraction**. See **MP3**.

RISC—See **reduced instruction set computing**.

riser card—A card that extends an expansion slot to make room for an expansion card that would otherwise not fit. The term also refers to a circuit board that holds several expansion slots. Generally, expansion slots are located on the motherboard, but in an rare cases, a riser card may be used to save space.

RLL encoding—See **run-length limited encoding**.

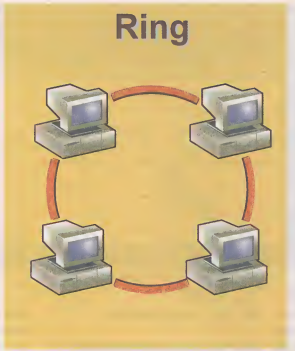
robot—A machine designed to respond to input from its surroundings and make changes based on that input. Often robots are made to re-create human actions, such as lifting, welding, or other industrial jobs. Also another term used to describe a search engine's spider, which is software used to collect information about the World Wide Web. See **spider**.

RMI—File extension used for MIDI sound files. See **MIDI sequencer device**.

robotics—The field of study dealing with robots. See **robot**.

robustness—A quality of hardiness; the ability to continue working properly in unusual or difficult situations. In computing, this may refer to hardware's physical durability or software's ability to handle unusual situations without crashing.

rollback—When a computer user runs into serious problems in a program, rollback is the process of returning the computer to its previously secure position. In transaction processing, rollback means to return to a state previous to the start of the transaction.



ring topology

roll in—To load memory areas from disk to virtual memory. See **virtual memory**.

roll out—To store areas of virtual memory on disk. See **virtual memory**.

ROM—See **read-only memory**.

roman—A type of font. Roman characters are straight up and down, as opposed to italic, which are slanted.

ROM BASIC—Before BASIC was stored in read-only memory (ROM), users of computers with this language had to load it from disk or tape each time the computer was turned on. See **BASIC**.

ROM BIOS—See **Basic Input/Output System**.

ROM card—A plug-in card, similar to a PC card, that holds programs in read-only memory (ROM). See **read-only memory**.

ROM cartridge—A plug-in card similar to a read-only memory (ROM) card, but larger. See **ROM card**.

root—The highest level in a hierarchy; in computer systems, this usually refers to the main directory.

root directory—The mother of all directories. The root directory is the one from which all the other directories branch out; it has no parent directory. The root directory of a drive is the letter name of that drive followed by a backslash; for example, the root directory of the C: drive is the C:\DIRECTORY. See **directory**.

rotational delay—How much time passes between the request for information located on a disk and when the sector rotates to the read/write head, where the information then can be retrieved. See **head**.

RO terminal—See **read-only terminal**.

round robin—Allowing more than one device access to resources, in turns. Each device or process uses the resources, and then the resources are allocated to the next device or process in the line. This is comparable to round robin letters used in many large families and groups, in which each person reads and adds to the letter before mailing it to the next person on the list. See **device**.

router—The part of a communications network that receives transmissions (information) and forwards them to their destinations using the shortest route available. Data may travel through multiple routers on the way to its destination. See **network**.

routine—An executable section of code in a program.

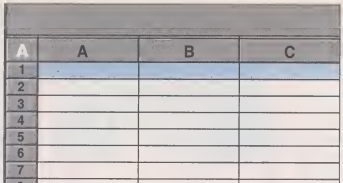
routing—The path a message takes from its point of origin to its destination on a network.

routing switch—A network device that combines switching and routing functions. A new chip architecture and combined functions provide a significant speed boost for networks with overworked routers. Traditional switches only create connections between computers or networks—they cannot direct traffic as routers can. Routing

switches, on the other hand, direct traffic in addition to providing links. Routing switches use special integrated circuits to perform routing at multigigabit speeds. They are increasingly popular with network designers and administrators who have watched bottlenecks emerge with overburdened networks. Until recently, most of the traffic on a network involved file and printer sharing, but with the exponential growth in network use due to the Internet, intranets, and wide-area networks (WANs), the load on routers has become so great that new technologies to send data on their way are needed. The new switches also have the advantage of lower cost compared to their predecessors. See network. See router. See wide-area network.

row—Data laid out in a horizontal line. The opposite is a column.

row address strobe—A signal sent from the central processor or memory controller to a dynamic random-access memory circuit that tells it which row a particular bit of data is in. It's used in conjunction with the column address strobe (CAS) to pinpoint the location of information in a row-column memory matrix. See column address strobe.



row (highlighted)

RPC—See remote procedure call.

RSI—See cumulative trauma disorders.

RTC—Short for real-time clock. See clock.

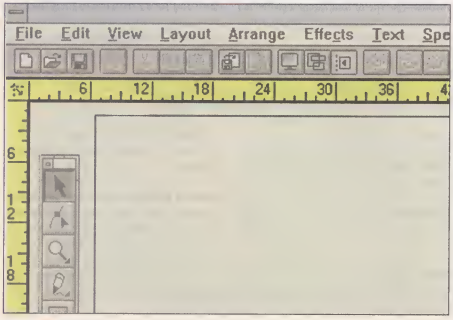
RTF—See rich-text format.

RTS—See request to send.

rubber banding—In graphics programs, when a user grabs one portion of a line or image and moves it while other parts stay anchored, causing the line or image to stretch.

RUBOUT key—See BACKSPACE key.

ruler



rule—A solid line used in page layout to separate columns or to make the page more aesthetically pleasing.

rule-based system—See expert system.

ruler—Similar to a physical ruler, this ruler is placed at the top of application windows to denote margins and other typographical guides. Most programs give the user the option to display or hide the ruler.

run—To begin a program or use a program.

run around—Placing or wrapping text around a graphic or image on a page.

run-length limited encoding (RLL encoding)—A way of storing information on a hard drive. This method of storage is carried out by hardware in the disk controller and is less prevalent than the modified frequency modulation (MFM) encoding scheme. See modified frequency modulation.

running foot—Text that appears in the bottom margin of a page such as the page number.

running head—Text that appears in the top margin of a page, such as the chapter name or title.

runs on—The ability of a program to work on a certain kind of computer. For example, a software package may be labeled "Runs on 386-based computers," which means the program will work on computers with an 80386 central processing unit (CPU). Compare to runs under.

runs under—The ability of a program to work with an operating system or environment. This may imply that the software only works with that operating system. For example, if software is marked "Runs under Windows 95," it is compatible with Windows 95 and may not run under earlier versions. Compare to runs on.

run time—How long it takes a program to run.

runtime error—An error that takes place while a program is running.

R/W—See read/write.

RXD—See receive data.

Sad Mac—A Macintosh icon that may appear at startup if the computer has trouble loading the operating system. The Sad Mac could mean anything from an incompatible system, a SCSI conflict, or a bad memory chip. Compare to **Happy Mac**.

safety ring—A plastic ring that fits into a reel of magnetic tape to prevent its files from being overwritten or erased. See **file protect ring**.

sampling—A primary way in which analog information, such as sound waves and moving images, is digitized so it can be manipulated by computers and other digital devices. Instead of recording an entire sound as a tape recorder might, a sampling device or software takes "snapshots" of the sound or video repeatedly at a high rate of speed. To the human eye or ear, these samples, when played back consecutively, appear to be seamless sound and video. It can be compared to a fast form of stop-motion photography. The sampling rate, which is the length of time between samples, determines the quality of the finished digitized product. In statistics applications, sampling can mean acquiring data from a source by measuring a representative sample. See **sampling rate**.

sampling rate—The frequency at which the computer records bits of analog information, such as sound. The faster the rate, the more realistic a sound will be when played back although it will take up more storage space because there are more frozen frames. See **sampling**.

SANE—See **Standard Apple Numeric Environment**.

sans serif—Without serifs, the small lines that adorn the tops and bottoms of letters in some fonts. One example of a sans serif font is Arial. Compare to **serif**.

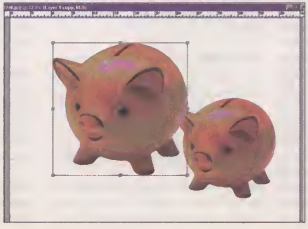
SAP—See **service advertising protocol**.

satellite computer—A computer that is on a distant communications link to a more powerful system.

saturation—The highest amount of electrical current a conductor can support. Also, a measure in desktop publishing of how much hue is in a color. For example, if a mixed color is 90% red, it has a red saturation of 90%.

save—Writing data to a permanent storage area, such as a diskette or the hard drive. Most applications include a save command that saves the current document to a user-specified location. If an existing file is opened, then altered, the save command will save the changes to the original file location. Compare to **save as**.

scale (enlargement)



save as—To write data to a storage medium under a different file name. Most applications include the save as command, which saves the current document to a user-specified location with a user-specified file name. If an existing file is opened, then altered, the save as command will save a copy of the altered file under a new name without deleting the previous, unaltered copy of the file. Compare to **save**.

scalable font—A font that can be manipulated to generate characters of variable sizes. Unlike bit-mapped fonts, the size of the characters can be changed without using a new file of characters. These fonts are stored as a series of mathematical expressions that define the curves and line of the letters. Also called a vector font. Compare to **bit-mapped font**. See **outline font**.

scalar—A single number or value. Compare to **matrix**. Compare to **vector**.

scalar processor—A processor designed to quickly compute scalar values. See **scalar**.

scalar processor architecture (SPARC)—A type of microprocessor architecture that includes a scalar processor. Developed by Sun Microsystems, it is a form of the reduced instruction set computing (RISC) microprocessor. See **scalar**. See **scalar processor**. See **reduced instruction set computing**.

scale—To alter the size of an image. Scaling an image up enlarges it while scaling an image down makes the picture smaller.

scan—To digitize an image through the use of a scanning device. See **optical scanner**. Also can mean to look at a file piece-by-piece or line-by-line.

ScanDisk—A utility that looks for and corrects disk errors. ScanDisk checks the directory structure and boot sector of hard disks, diskettes, and removable drives. Also examined are the file allocation table (FAT), individual files, and the physical surface of the disk. ScanDisk should be run at regular intervals because the utility can prevent some major hard drive failures and data loss by identifying a disk's problem areas.

scan head—The part of a scanner that moves over an image and then scans it.

scan line—A horizontal row of pixels. See **pixel**.

scanner—See **optical scanner**.

scan rate—The rate at which a computer redraws an image on-screen. The image is redrawn many times per second. The faster the scan rate, the more steady the resulting image. Slow scan rates can make the image appear to flicker. See **refresh rate**.

SCC—See **serial communications controller**.

schema—Term applied to the actual structure of a database, usually used to describe the graphical interface such as tables, columns, or fields.

scissoring—See **clipping**.

scratch—A file or place in memory storage that a computer uses to store information being entered or modified by the user. After the application is closed, the information is either saved to a more secure location by the user or deleted by the PC. The scratch file is created as a precautionary measure by some applications to save information in case the system loses power. The user normally does not know the scratch file has been created. If the user has not already saved the information to another location, it can sometimes be retrieved from the scratch file. See **temporary directory**. See **temporary file**.

screen savers (various)

scratchpad memory—A small reserve of memory that holds the most commonly used files for quick and convenient access by the processor. See **cache**.

screen—See **display screen**.

screen buffer—See **video buffer**.

screen capture—See **screen shot**.

screen dump—See **screen shot**.

screen flicker—The appearance of a flicker or unsteadiness in an image on a monitor's screen. The flicker can have several causes. If the refresh rate is too slow for the application currently running, the image is not being redrawn quickly enough to display the most current image. Low-persistence phosphors are more likely to cause flicker

screen font—A font designed specifically for display on a monitor. Screen fonts are usually formatted as bit maps for the slower resolution of the monitor screen. Compare to **printer font**.

screen map—See **screen buffer**.

screen saver—A simple program that activates when a computer has been inactive for a specified period of time. Screen savers, often moving image or graphic displays, were originally designed to prevent images from being burned into monochrome monitors. Any image left unchanged on a monochrome monitor for an extended length of time ran the risk of leaving a permanent imprint. Today's new monitors no longer run the risk of having their screens imprinted by images, but screen savers are still popular for their entertainment value.

screen scraper—A program that lends a graphical user interface (GUI) to a text-driven legacy application. The screen scraper can be either a program that runs on a desktop computer or a Web interface. A good example of a screen scraper is the Travelocity Web site, which provides a Web interface to an antiquated airline reservation system that uses a text menu and archaic commands for navigation. See **graphical user interface**. See **legacy**.

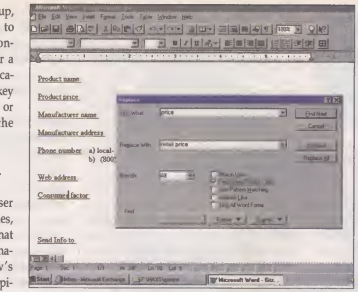
screen shot—A picture of the contents of a monitor's screen. A screen shot can be sent directly to a printer or, more often, stored as a file. It also can be imported into other applications. Also called a screen dump or screen capture.

script—A sequence of commands the computer executes at the touch of a button or a short series of buttons. See **macro**.

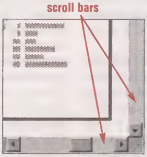
scroll—To move the screen up, down, left, or right in order to bring more data into view on-screen by using the cursor or a set of scroll bars. Some applications may require the use of key combinations, such as PG UP or PG DN, instead of using the scrolling method.

scroll arrow—See **scroll bar**.

scroll bar—In graphical user interfaces, a bar along the sides, top, or bottom of a window that allows the user to view information outside of the window's viewing area. Scroll bars are typically manipulated using the mouse. Scroll arrows at each end of the scroll bar can be clicked to move the viewing area slightly in the specified direction. The scroll box can be moved up and down or left and right inside the bar to move the viewing area more rapidly. See **horizontal scrolling**. See **vertical scrolling**.



search and replace



scroll box—In graphical user interfaces, a small square object inside a scroll bar that indicates the position of a window's viewing area and can be moved to change that viewing area. See **scroll bar**.

SCROLL LOCK key—A key on the keyboard that can sometimes be used with the PAUSE key to temporarily halt an operation. Most of the time, SCROLL LOCK does not have a standard function. Some applications will accept its command, but often, the key does nothing.

SCSI—See **Small Computer System Interface**.

SCSI-2—A newer Small Computer System Interface (SCSI) standard. The SCSI-2 can transfer up to 40 megabytes (MB) of data per second on a 16-bit or 32-bit bus system, considerably faster than its predecessor. The improved interface also was designed to correct some of the incompatibility problems SCSI had with adding additional devices. With SCSI-2, scanners, hard drives, and CD-ROM drives, as well as other devices, are now more easily connected. See **Small Computer System Interface**.

SCSI bus—The connection used to transport information from the Small Computer System Interface (SCSI) device controllers to the SCSI interfaces. Through the SCSI bus the attached peripherals, such as the printer, can communicate with the interface. See **bus**. See **Small Computer System Interface**.

SCSI cable—A wide cable with rectangular connectors that connects the Small Computer System Interface (SCSI) devices, one to another, as in a daisy chain formation. See **daisy chain**. See **Small Computer System Interface**.

search engine

SCSI chain—A link of several Small Computer System Interface devices. See **Small Computer System Interface**.

SCSI device—Requires a connection with a Small Computer System Interface (SCSI) cable. Some CD-ROM drives are SCSI devices. See **Small Computer System Interface**.

SCSI port—The connector that a Small Computer System Interface (SCSI) cable plugs in to. See **Small Computer System Interface**.

SCSI-to-SCSI cable—See **SCSI cable**.

scuzzy—See **Small Computer System Interface**.

SDLC—See **synchronous data link control**.

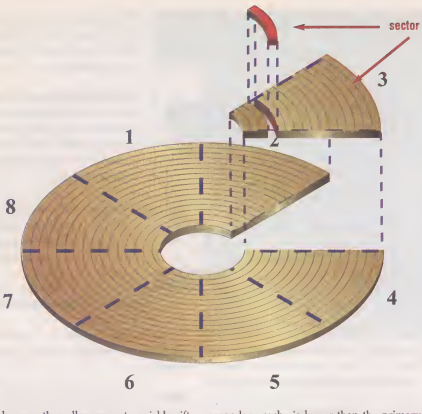
SDRAM, SDRAM II—See **Synchronous Dynamic random-access memory**.

seamless integration—To add hardware or software to a system with each component fitting into the balanced system without complication.

search—To look for a specified word, term, or combination of keystrokes in a word processor, a spreadsheet, a database, or some other document. Many applications include commands that let the user perform such searches. Many operating systems also include search commands that let the user find a certain file or directory on a storage medium such as a hard drive. Also called find or seek. See **search and replace**.

search and replace—To find data, such as a word, phrase, or combination of keystrokes, and replace it with another piece of data. Many applications such as word processors, spreadsheets, and databases include commands that make it easy for the user to perform such actions automatically.

search engine—A program that allows users to locate specified information from a database or mass of data. Search engine sites are extremely popular on the World Wide



Web because they allow users to quickly sift through millions of documents on the Internet. AltaVista (located on the Web at http://www.altavista.digital.com) is one example.

search key—A word, search string, or file name being searched for, or the specified directory or field to be searched. See search.

search operators—Terms that help define a search, either by limiting or expanding its scope. These terms are commonly used in World Wide Web search engines and directories, such as AltaVista, Yahoo!, and HotBot. For example, the search operator AND would limit a Web search by requiring not merely one word of a series to be found in a Web page, but both (or all) of the words. The operator OR, on the other hand, would expand a search by returning pages that contained either of the words. See Boolean.

search string—The combination of characters for which a search is being conducted. See search.

secondary cache—Also referred to as Level Two (L2) cache. A segment of cache memory stored outside the central processing unit (CPU). Typically external, the secondary cache is larger than the primary cache. See cache.

secondary channel—A channel on a communications device that carries diagnostic information. The secondary channel runs parallel to the channel that carries data.

secondary key—A more specific search key subgroup used to narrow the scope of search fields. See search key.

secondary storage device—Storage, such as a tape drive, other than a computer's main storage area, which is usually a hard drive. Many secondary storage devices are designed for backup purposes and operate as a computer's warehouse for long-term data storage.

sector—A division of a storage medium, such as a hard drive or diskette. Diskettes or hard drive platters are divided into wedge-shaped sections that segment the circular tracks into small arcs. Each arc is a sector that typically holds 512 bytes of data. All the arcs within a given wedge are given the same sector number for interleaving purposes, so the term sector may refer to the entire wedge-shaped section of the platter or just a single arc. The size of sectors can be customized to maximize the storage area. For example, if a user stores smaller files, decreasing the sector size allows more files to fill the space without any leftover room. See interleave.

sector interleave—See interleave.

Secure Multipurpose Internet Mail Extensions (S/MIME)—S/MIME is an E-mail standard that builds on the MIME standard by either encrypting or adding digital signatures to MIME-formatted messages. Encrypting the message prevents the reading of intercepted mail. Digital signatures prove to the reader that the message is from who it says it is, and thus it prevents forgeries. S/MIME is an open standard, meaning any software developer can implement it. See digital signature, Multipurpose Internet Mail Extensions.

secure sockets layer (SSL)—The most popular security protocol for the Internet, provided by Netscape Communications Corp. SSL encrypts data that passes over the Internet. Netscape Navigator and Microsoft Internet Explorer support SSL.

security—A system of measures for keeping information on a system safe from corruption or prying eyes. Security can mean anything from a screen saver with a password to encrypted data that keeps users from reading information without the proper decoding software.

seek—See search.

seek time—The time it takes for a hard drive's read/write head to move to a particular spot on a disk to find data.

select—To choose an option or an object to open. Also can mean to highlight a character, word, or block of text. See highlight.

selection—A chosen object, option, or text block.

selection sort—A search for specific information from a database. Each data file that matches the parameters given is set aside for inclusion in its own special report.

selector channel—A high-speed input/output (I/O) channel that links a peripheral

device, such as a hard drive or CD-ROM, to the computer.

self-extracting archive (SEA)—A type of self-extracting file most often found in Macintosh systems.

self-extracting file—A compressed file, usually denoted by the file extension .SEA, that includes the necessary executable program to decompress itself upon command. Normally, executing such a file will begin the decompression process. See **file compression**.

semiconductor—A solid material that can fluctuate between an insulator and a conductor depending upon its manufacturing process. Often used to refer to electronic components of all types.

send-receive fax modem—A fax/modem that can both send and receive information. See **fax/modem**.

sensor—A device used to detect real-life conditions and translate them into computer data. Sensors of varying complexity can be used to detect almost every force known to humans. The most common sensors detect motion, heat, sound, or light and other electromagnetic radiation.

sequence check—To test a list of files, records, or other data storage to make sure they are in the proper order.

sequenced packet exchange (SPX)—The communications protocol used by Novell's NetWare to direct a network message transmission. SPX makes sure all messages reach their destination complete.

sequential access—A method of data retrieval in which the computer must read a storage device from the beginning until it reaches the necessary information, analogous to finding a certain part of a movie on a videotape. Also called serial access. Compare to **direct access**.

sequential execution—To execute programs or commands in the order in which they were written. Compare to **concurrent execution**.

sequential processing—To process information in the order the values were stored in or in the order of initial entry. Also called serial processing.

sequential search—See **linear search**.

serial—One after another. Information transferred serially is transmitted bit-by-bit, or sequentially. Compare to **parallel**.

serial access—See **sequential access**.

serial channel—See **serial port**.

serial communications—The bit-by-bit transmission of data between the processor and peripherals. For serial communications to be effective, the receiver and the sender must have compatible baud rates or transfer speeds.

serial communications controller (SCC)—A Macintosh chip that controls a computer system's serial ports.

serial device—A device that communicates through serial transmissions that flow through the channel bit by bit.

serial interface—A data channel that transfers digital information one bit at a time, usually between a computer and a peripheral. Serial interface also is used to refer to a device that translates data arranged in a parallel fashion into a serial manner, then transmits it, and changes the data back again when the transmission is complete. Compare to **parallel interface**.

Serial Line Internet Protocol (SLIP)—An Internet protocol that allows users to gain Internet access with a modem and a telephone line. SLIP allows users to link directly to the Internet through an Internet service provider. SLIP sends its transmissions over a serial line, such as a telephone line. It is being replaced by Point-to-Point Protocol (PPP), which provides enhanced error detection and automatic configuration. Compare to **Point-to-Point Protocol**.

serial mouse—A mouse that connects to the computer through a serial port.

serial port—An input/output channel for serial data communication. A serial port is the connection point on a computer used to connect a serial interface device to the system, such as a mouse and/or a modem. Serial ports are typically identified as communication (COM) ports. Most computers come with two serial ports and many have the capacity to accommodate four or more. See **serial interface**.

serial port

serial printer—A printer connected to a computer through a serial interface. The serial printer is generally regarded as a slower and less compatible option to the parallel printer. Some of the problems stem from the variety in the connectors; most are female, some are male. Among the genders, some connectors have a different number of pins. Despite these PC problems, serial printers are the Apple microcomputer standard. See **serial interface**. See **parallel interface**. Compare to **parallel printer**.

serial processing—See **sequential processing**.

serial transmission—Sending information over a wire one bit at a time. Compare to **parallel transmission**.

serif—Having short decorative lines attached to the upper and lower ends of characters in a typeface. As a noun, the word means the small lines themselves. An example of a serif typeface is Times Roman. Compare to **sans serif**.

server—The control computer on a local-area network (LAN). The server controls software, access to printers, and other parts of the network. The server is usually accompanied by workstations that share the main system's resources. A network may have more than one server. A server may be dedicated, meaning its sole purpose to be the server, or nondedicated, meaning it can be used for basic computing in addition to acting as the server. See **local-area network**.

server mirroring—Simultaneously copying data to more than one server. In the event that the main server crashes or data from the main server is lost, another copy of the information is immediately available.

service advertising protocol (SAP)—A protocol used by servers to inform clients they are on the network in Novell's NetWare environment.

service bureau—A data processing center that conducts data processing as a paid service for customers. Also refers to a business that takes electronic documents from customers and prints them on media such as paper, transparencies, slides, and other hard-copy materials.

service protocol gateway (SPG)—A program used in the Novell NetWare environment that formats Apple transmissions into a form that NetWare can use.

service provider—See Internet service provider.

settling time—The time it takes a drive read/write head to settle into position.

set-top box—A device used with a television, typically placed on top of the television, that adds some type of computing function. Presently, set-top boxes are used to provide Internet services, such as WebTV. The boxes are computers with minimal amounts of memory and processing power and frequently have no hard drive. They perform tasks that don't require much computing power at a fraction of the cost of a full computer. See Internet.

set up—To ready system hardware or software for operations. Setup is often the name of the installation program that comes with most applications. The user must execute this program to install the software on a computer and configure it to use the system hardware properly. See install.

sex changer—See gender changer.

SGML—See Standard Generalized Markup Language.

shadow—In printing, word processing and publishing programs use shading (usually in gray, but sometimes in color) to give text the appearance of depth, by making it appear to have a shadow. The program creates the effect by placing a duplicate of each character down and slightly to the side of the original. In OS/2, a shadow links two objects located in different folders. When changes are made to one of the objects, those changes appear in the second object, as well.

shadow BIOS ROM—See shadow memory.

shadow mask—A perforated metal sheet placed between a monitor's electron gun and the screen's phosphor coating that isolates the phosphors, providing targets for the electron gun. See electron gun. See phosphor. Compare to aperture grill.

shadow memory—A portion of memory that helps make a system faster by sending any requests for the Basic Input/Output System (BIOS) to the random-access memory (RAM) shadow for execution instead of searching throughout all of RAM. Also called shadow ROM, shadow RAM, and shadow BIOS ROM.

shadow printing—A printing technique that produces a replica of each character in a lighter shade and slightly off center so it appears the letter has a shadow.

shadow printing

shadow RAM—See shadow memory.

shadow ROM—See shadow memory.

shadow server—See backup server.

Shannon's Law—A mathematical formula that states the theoretical maximum bandwidth available on phone lines is 35 kilobits per second (Kbps). The figure is derived by considering the multitude of impairments (namely noise) on phone lines. Modems that operate at 56Kbps break Shannon's law by using digital equipment at the remote end (at the Internet service provider) to provide a cleaner phone line with less noise. Without one end of the phone line using digital equipment, 56Kbps speed is out of reach. For example, if two users with 56Kbps modems directly connected, their modems would still not be able to communicate at speeds higher than 35Kbps without the special digital equipment at one end. See bandwidth. See kilobits per second. See modem.

shared directory—A directory on a network accessible to multiple users. The files in such a directory might be stored on the server or the hard drive of another user's computer. A computer system might have shared and unshared directories on the same hard drive with different levels of security. See network.

shared folder—A Macintosh computer's version of a PC's network directory. Describes a folder accessible to multiple users on the network.

shared logic—When multiple circuits or applications use the same circuitry or software routines. Also refers to more than one person using the same terminal.

shared memory—A segment of memory available to more than one application at a time.

shared network directory—See shared directory.

shared resource—A device, program, or piece of information used by more than one application or computer at once. An example of a shared resource is a laser printer that an entire local-area network (LAN) can access. Most shared resources are linked to multiple users through a network of some kind, but a network link is not absolutely necessary to share a peripheral device such as a printer.

shareware—Copyrighted software distributed on a free-will donation basis either via the Internet or by being passed along by satisfied customers.

sharpness—The clarity of a monitor's picture or a printed image. See resolution.

sheet feeder—A paper tray on a printer that accepts tacks of paper and feeds them through the machine one by one. Also called cut-sheet feeder.

sheet feeder

sheetfed scanner—See optical scanner.

shell program—A program that provides an interface between the operating system and the user. For example, DOS Shell is a DOS command that provides a menu-driven interface. Users can navigate the operating system without trying to memorize commands.

shielded twisted-pair cable—See twisted-pair cable.

shift clicking—A selection procedure where the user holds down the SHIFT key while pressing a mouse key. See **SHIFT key**.

SHIFT key—A keyboard key that, when depressed simultaneously with another key, changes the effect of that key. For example, a lowercase *o* becomes an uppercase *O* when the SHIFT key is used. See **shift clicking**.

short card—An expansion card half the size of standard expansion cards. Because so many expansion cards really only require a small part of the available board space, the short card is designed to make better use of that space. Many standard cards are full-sized only to conform with the standard board shape, not because they need to be that big. Most systems are built with a limited number of half-sized slots, but standard cards obviously are not compatible with them. See card.

shortcut—A link to a file or location. On Windows computers, shortcuts can point to a drive, file, or server. By placing a shortcut on the Desktop, users can access those resources by double-clicking the shortcut instead of digging through directories.

shortcut key—A key or key combination that executes a specific function or command within an application or operating system. For example, the F7 key in Microsoft Word 6.0 initiates the spelling checker while the F12 key initiates the Save As command. Also called an application shortcut key. A shortcut key can be specified with a specific software package, such as using the ALT key plus the first letter of a pull-down menu option, or it could be a user-created macro.

short date format—Expressing a date as numbers instead of writing it out. For example, instead of December 31, 1999, it would be expressed in the mm/dd/yy format; that is, 12/31/99, or the mm/dd/yyyy format (12/31/1999). Outside the United States, the month and date are often transposed, making the format dd/mm/yy or dd/mm/yyyy. Some software analysts recommend Windows users use the Regional Settings control panel to change the short date format to specify four-digit years to check software on their computer for Y2K compliance.

short-haul—A communications line or modem that transmits data only over short distances. Compare to long-haul.

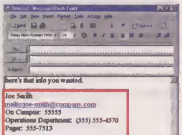
shut down—To close applications in preparation to turn off a computer's power. The operating system is generally the last program to be closed. In Windows 3.x, this is accomplished by closing the Program Manager as you would any other program. Windows 95 and Windows 98 include a Shut Down command in the Start menu.

side grade—A new software product closely related and/or complementary to a product from the same company currently on the market, such as Microsoft's Works and Word programs.

SIG—See special interest group.

signal-to-noise ratio—A figure used to measure the quality of a connection, whether a phone line or network cable. The higher the signal-to-noise ratio, the better the connection in terms of speed and reliability. The term also is, informally used to describe the atmosphere of an Internet newsgroup or mailing list. In this case, the fewer off-topic posts there are, the higher the signal-to-noise ratio.

signature—Data used for identification. Many E-mail users include a short two- or three-line signature at the bottom of their messages indicating their name, job position, phone number, or other information.



signature

signature file—A user-configured file that is automatically appended to E-mail messages and newsgroup posts. Users often put in a signature file with their names, other identification, and a favorite quote. Sig-

S

nature files are usually text files, but some newer mail readers may store it as a Hypertext Markup Language (HTML) file. See **signature**.

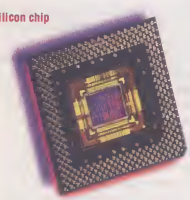
sign off—To close out a network connection while working on a network PC. On a standalone system, signing off is equivalent to closing applications and going through the shut down procedure. See **logoff**. See **shut down**.

sign on—To open a network connection by telling the computer it's time to begin, usually by entering a password. See **log in**.

silicon—The fundamental material used in making computer chips. It is an excellent semiconductor. See **semiconductor**.

silicon chip—An integrated circuit made primarily of silicon, the most common substance used in the making of computer chips.

silicon chip

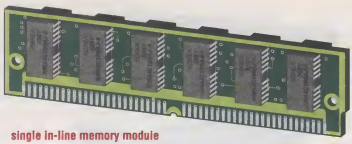


Silicon Valley—An industrial area in California, with a large concentration of computer-related industry. The geographical locations include Palo Alto, Los Altos, Mountain View, Sunnyvale, Cupertino, Menlo Park, Fremont, and Santa Clara.

SIMD—See **Single Instruction Multiple Data**.

SIMM—See **single in-line memory module**.

Simple Mail Transfer Protocol (SMTP)—A communications protocol that directs E-mail exchange on TCP/IP networks. See **Transmission Control Protocol/Internet Protocol**.



single in-line memory module

simplex transmission—The transmission of data in only one direction. For example, a print job can only travel from the PC to the printer, not both ways. Compare to **full-duplex transmission**. Compare to **half-duplex transmission**.

simulation—A computerized imitation of a real object or action.

simultaneous peripheral operations online—See **spooling**.

single board computer—A computer with the capacity for only one board or card with no capacity for additional circuitry being physically added. All components necessary for the system's function are contained on the one board.

single-density diskette—The first type of diskette produced. It can only support "one-sided" recording. For this reason, this diskette can't hold as much information as double-density diskettes. Compare to **double-density diskette**.

single in-line memory module (SIMM)—(Pronounced simm.) A slender circuit board dedicated to storing memory chips. The chips are random-access memory (RAM) upgrade chips used to expand the system's RAM capacity. More than one SIMM may need to be installed at one time.

single in-line package (SIP)—(Pronounced sipp.) A form of chip packaging that has only one row of connection pins rather than the two rows found in dual in-line packages (DIPs).

Single Instruction Multiple Data—A performance enhancement included in Intel's MMX microprocessor technology that allows a single instruction to run simultaneously on multiple data items. Intel's analogy is it's like a drill sergeant issuing the "about face" order to a platoon instead of issuing the order to each soldier one at a time. Instead of using loops to repeat the command for each data item, the task can now be performed in one instruction. According to Intel, such loops account for only 10% of the code in modern multimedia and communications programs but takes up 90% of those programs' execution time. By reducing the execution time, the load on the computer's processor is reduced and system speed increases. See **data item**. See **instruction**. See **MMX**.

single-sided diskette (SSDD)—A diskette that stores data on only one side. Compare to **double-sided diskette**.

single step—To execute a program one step at a time. Usually used to find the flaw or error that is causing a program to run improperly.

single threading—To process only one command at a time. Compare to **multithreading**.

single-user computer—A system designed for only one user. Also called a PC.

SIP—See **single in-line package**.

site license—A license that gives permission to use a software package on more than one system. In most cases, it is illegal to have one software package simultaneously installed on more than one system. Site licenses are a means of providing a bulk rate to companies and schools that want to use software on many computers. The purchase pays for permission for each installation instead of paying for a new software package. The purchaser is still paying for each individual user, but at a reduced rate.

slate PC—A type of portable computer that accepts hand-printed lettering and translates it into a language a computer can understand.

slave—A computer or peripheral device that operates under the control of another computer or peripheral.

SLDRAM—See SyncLink Dynamic random-access memory.

sleep—A state of low-power inactivity. PCs and peripherals with sleep capability can be set to enter an energy-saving mode in which all but vital functions are shut down until the user "awakens" the machine. For instance, a monitor might go blank when in sleep mode. Often pressing any key on the keyboard will end a computer's sleep.

slimline model—A small desktop computer. The case may be as wide and as long as a regular desktop machine, but the height or thickness are slightly smaller.

SLIP—See Serial Line Internet Protocol.

SLL—See secure sockets layer.

slot—See expansion slot.

Slot 1—The receptacle on the motherboard into which a Pentium II processor is inserted. Slot 1 is a standard that sets the size of the socket and number of connecting pins. It allows users to remove the processor from the socket and replace it with a new one, but supports only Pentium II processors; older processors will not fit in the socket. See motherboard. See pin.

SLSI—See super-large-scale integration.

Small Computer System Interface (SCSI)—(Pronounced scuz-zee.) A standard for parallel interfaces that transfers information at a rate of up to 80 megabytes per second (MBps). Up to seven peripheral devices, such as a hard drive and CD-ROM drive, can attach to a single SCSI port on the system's bus. SCSI ports were designed for Apple Macintosh and Unix computers, but also can be used with properly equipped PCs.

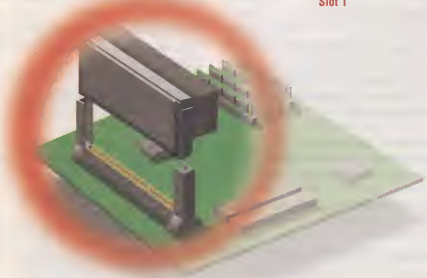
small office-home office (SOHO)—(Pronounced so-hoe). A target computer market consisting of users who work at home or in small businesses.

small-scale integration (SSI)—A type of chip architecture that has fewer than 30 transistors per chip. This chip design is most prevalent in older laptop and personal computers.

smart—The ability of a computer or program to function for itself by processing data or having a small amount of independent processing ability. Also called intelligence.

smart battery—A portable computer battery that keeps its system up-to-date about its power status. Also called an intelligent battery.

smart cable—A cable with built-in circuitry to detect transmission protocol and translate it for the receiver. As signals travel from one device to another, the circuitry translates the signal from one protocol to another. Also called an intelligent cable.



Slot 1

smart card—A circuit board with its own processing capabilities that provide it with some decision-making ability. In banking, a smart card also refers to a credit card with an embedded integrated circuit that gives it a limited amount of memory. This type of smart card is often used for financial transactions.

smart terminal—A terminal that has its own processor, memory, and software to function as a fully independent machine. An intelligent terminal is independent of networks or outside connections. All components needed for its job are contained in one package. Also called an intelligent terminal. Compare to dumb terminal.

S/MIME—See Secure Multipurpose Internet Mail Extensions.

SMS—See Systems Management Server.

SMT—See surface-mount technology.

SMTP—See Simple Mail Transfer Protocol.

SNA—See systems network architecture.

snail mail—Slang for traditional paper mail sent by a postal service, taken from its relative slowness to arrive compared to electronic mail.

snapshot—A record of the state of a system at a particular moment. Also can mean screen shot.

SND file—A file extension denoting a Macintosh sound file, usually in Audio Interchange File Format (AIFF). The file extension can be somewhat ambiguous because Sun workstations also save sounds with the SND file extension, but those are usually saved in a different format. See Audio Interchange File Format.

Sneakernet—Jargon that describes the transfer of data through physical means, mainly by walking diskettes or storage tapes from one location to another. Also called

Tennis-Net, Floppy-Net, Shoenet, and Walknet.

sniffer—A piece of hardware or software that monitors packets traveling over a network. Sniffers can be used by network administrators doing network analysis or hackers snooping around a network. Network administrators may need to use sniffers to monitor traffic to analyze traffic patterns on the network and plan future upgrades or additions. Hackers can use sniffers to sneak peaks at the data being passed over a network. For example, they could look at E-mail messages being passed over the network by sniffing the packets containing the E-mail messages. Sniffers can only snoop on the packets passing over the section of network they're on. For example, a sniffer on an office network could only sniff packets going in and out of that office, not the entire corporate network or the entire Internet. Sniffers are hard to detect because they don't disrupt traffic flow. See **hacker**. See **network**.

snow—A cast of pixels on a monitor that appear as small, white, flickering dots. Snow can be caused by simple interference or by conflicts within the video memory.

Socket 7—The socket on the motherboard into which a processor is inserted. Socket 7 is a standard that specifies the size of the socket and number of connecting pins. It was designed for the original series of Pentium processors. Socket 7 specifies a 321-pin socket and supports AMD, Cyrix, and Pentium processors. See **motherboard**. See **pin**.

S

Socket 8—The socket on the motherboard into which a Pentium Pro processor is inserted. Pentium II processors use a Slot 1 socket. Socket 8 sockets are Zero Insertion Force (ZIF) sockets, meaning the processor can be dropped into the socket then held in place by a lever. Socket 8 specifies a 387-pin connection and allows for upgrading with faster chips. Socket 8 sockets are incompatible with older Pentium chips, which require a Socket 7 socket and newer processor chips, such as the Pentium II chip, which requires a Slot 1 socket. See **motherboard**. See **pin**. See **Zero Insertion Force socket**.

soft—To be temporary or capable of change. For example, software gets its name from the idea that changes can be made by altering the programming code. By contrast, hardware is a physical contraption that can be added to or broken, but cannot be changed.

soft copy—On-screen images or text. Compare to **hard copy**.

soft error—An error that can be corrected, such as an error in programming code.

soft font—See **downloadable font**.

soft return—A carriage return automatically inserted in a word processing document. Soft returns allow users to continue typing without adding carriage returns manually.

soft-sectored disk—A disk that has had its sectors mapped with program commands rather than actual physical separations.

software—A set of instructions that tell a computer what to do. Software will generally contain a list of variables, representing numbers, text, or graphics, and a series of statements, which tell the computer how to process these variables. There are two basic software categories: system software and application software. Also called a program. Software is usually stored on a storage device such as a hard drive until needed by the computer. Then parts of a particular program are loaded into the system's memory. See **application**.

software conversion—See **conversion**.

software-dependent—A system dedicated to one specific software application or set of applications. Usually the applications have been specially designed for the system and the purpose.

software engineering—The programming and production that goes into the software development process.

software house—A software development organization.

software library—A collection of software owned by a single company.

software piracy—The illegal use, copying, or distribution of software. Most software products instruct the user that only one copy of the product may be installed on a system at any given time. A user agrees to the terms of the licensing agreement when the product is purchased and installed on a system. With most products, installing one software package on multiple systems used by the same person would be considered piracy. Compare to **shareware**.

software portability—See **portability**.

software publishing—The design and distribution of software packages designed for consumer use.

SOHO—See **small office-home office**.

solid inkjet printer—A printer technology that uses wax-based inks that melt and are sprayed on to paper. The wax then dries quickly and adheres to almost any surface.

solid-state device—A device with no moving parts, usually one made up largely by electronic circuitry. Solid-state devices, such as transistor radios, are less likely to wear out than nonsolid-state devices because there are no mechanical parts to erode by overuse. A CD player, on the other hand, has a motor that moves to spin the disc around for playback. While it contains some solid-state components, a CD player is not a completely solid-state device.

solid-state memory—A memory type stored within solid-state devices. Random-access memory (RAM), an example of solid-state memory, is stored in silicon chips on single in-line memory modules (SIMMs).

solid-state relay—A switch with no moving parts. See **switch**.

sort—To organize data. For example, the information in a database can be sorted alphabetically, numerically, by keywords, and in other ways.

sort field—The information category that a sort process uses to organize the database information. For example, "last name" might be a sort field.

sort key—A keyword or character set used to arrange information into a desired order.

sort within a sort—To organize data in a specific subcategory of information within a larger group. For example, organizing a list by date of purchase and then alphabetizing the names that appear in each date is an example of a sort within a sort.

sorter—A program or application that sorts information.

sound buffer—A portion of memory that temporarily holds sound files on their way to audio speakers.

sound card—An expansion board that adds audio capability beyond basic beeps. A sound card is essential for any application that contains sound effects. There are three main sound standards: SoundBlaster, Ad Lib, and Windows. Some cards have capabilities for all three. Sound cards contain the equipment to digitize a sound by translating a sound from analog or real world to digital or computer language. The sound card produces sound in one of two ways: FM synthesis and wavetable synthesis. FM synthesis takes the mathematical representation of a sound and creates a sound from the formula, in much the same way that a music box plays a tune. Wavetable synthesis takes recordings of actual sounds and manipulates them to change pitch and dynamics. Also called a sound board or an audio card.

sound file—A file that contains digital audio, such as a WAV file. See **audio**. See **WAV files**.

sound generator—The electronic circuitry that produces sound.

sound hood—A lid-like box placed over a dot matrix printer or other impact printer to muffle the sounds of printing.

SoundBlaster—A type of sound card manufactured by Creative Labs. Because the brand is so popular, many other manufacturers will claim their sound cards are compatible with SoundBlaster. Most software that includes sound can use SoundBlaster-compatible sound cards. See **sound card**.

source—A resource such as a file or database from which data is retrieved.

source computer—A computer used to assemble a program.

source data—The original hard copy form of data that is used in a computerized program. The information is read from hard copy and inputted into the computer system, either using a high-tech scanner or old-fashioned, manual entry.

source data acquisition—To receive source data through scanners or manual input. Also called source data capture.

source data capture—See **source acquisition**.

source disk—The diskette from which data will be copied.

source document—The document from which the user retrieves information for use in another document or application.

source drive—The drive from which data is retrieved.

source program—The original programmer-written program.

space character—The character entered by the Spacebar. Although the space is a noncharacter to the person typing it, a computer interprets it as it would any other character.

space parity—A form of information integrity check that uses the 1s and 0s of the binary code to verify the validity of transferred data. See **binary**. See **parity**.

Spacebar—The long, horizontal bar on the lower edge of a keyboard that usually creates a blank space on the screen when pressed.

spam—As a noun, unsolicited bulk E-mail on the Internet or Usenet newsgroup postings sent to large numbers of newsgroups. As a verb, to send copies of the same types of messages. Advertisers often spam recipients intending to market products, Web sites, or commentary. The beneficiary often considers spam as junk mail, and it is considered poor form to send it. A person or E-mail address that receives many unwanted messages is said to have been "spammed."

spamdexing—Strategies used by some Web marketers and hosts as a way of keeping their services at the top of search engine results. Spamdexing includes submitting multiple, yet slightly altered, Web sites to a search engine, and "word stuffing," which places a word or keywords in a site numerous times, to ensure the search engine will bring up the site as one of the top keyword matches. Other techniques include "bait-and-switch" gimmicks, such as loading the site with frequently used keywords such as "free," "sex," "money," or "shareware," even though the words have nothing to do with actual site content.

span—See range.

SPARC—See **scalar processor architecture**.

spatial digitizer—A scanner used to input three-dimensional (3-D) objects. See **scanner**.

spec—See **specification**.

special characters—A character that isn't alphabetic or numeric. Punctuation marks are special characters. Any unusual character included with a font package also is considered a special character.

special interest group (SIG)—A group of people that share information and ideas about a specific topic. Many SIGs exchange ideas and software through bulletin board systems (BBSes), commercial online services, and the Internet.

special purpose language—A program language that was designed for a specific function. For example, a language might be more suited to mathematical or scientific uses than general-purpose programming.

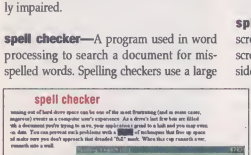
specification—Descriptive information about hardware or software products. For

example, a computer system's specifications might include its central processing unit (CPU) speed, bus speed, hard drive size, amount of random-access memory (RAM), number of expansion ports, and other information.

speech recognition—See voice recognition.

speech synthesis—A computerized simulation of the human voice. A computer can piece together prerecorded words or simulate the sound from a mathematical formula to allow a form of audio interaction between computer and user. Speech synthesis currently is most commonly used for the visually impaired.

spell checker—A program used in word processing to search a document for misspelled words. Spelling checkers use a large database and comparison techniques to bring unfamiliar words and phrases to the user's attention.



SPG—See service protocol gateway.

spider—A program that "crawls" across the World Wide Web, automatically collecting Web pages. Most spiders will follow every link on a page, cataloging each page, until it comes to a dead end. Then it will start over on a new page. Spiders are used primarily by Web search engines to gather data for the search engine's database. Search engines don't actually search the entire Internet when a user enters a search term. Instead, they look at the database of Web pages collected by their spider. Spiders are also known as crawlers and bots.

spike—A temporary increase in the amplitude of a signal.

spindle—A post that holds a reel of magnetic tape.

SPL—See systems programming language.

splash screen—A World Wide Web page with a picture, graphic, or a short phrase that leads into a Web site. Splash screens make a quick, dramatic impression on surfers before entering the heart of the Web site. They usually require the surfer to click a picture or graphic to enter the site or wait a few seconds before automatically proceeding. Splash screens are also especially handy for important or late-breaking news and announcements that might otherwise be lost in the clutter of a main page.

split bar—The bar that divides a split screen. The line appears in the middle of the screen, but it can be moved up and down or side to side to alter the size of the windows.

split screen—A software-activated division of the screen in which different documents can be displayed. Each document can be manipulated individually. Also called split window.

split window—See split screen.

spoof—Gaining access to a network or network services by posing as a legitimate user. The simplest way to do this is by gaining the user name and password of a legitimate user. Once the unauthorized user gains access to a network, he or she can then gain access to private files or resources. E-mail messages may be forged by making it appear to have come from a legitimate user. Spoofing is also used by those performing denial-of-service (DoS) attacks because it helps hide their identity. Spoofing also has legitimate uses. For example, some routers spoof replies from remote servers to reduce the traffic on a wide-area network (WAN). In general, computers on local-area networks (LANs) are always checking up on the status of the network and making sure remote hosts are still online. That causes a lot of network traffic, so some routers have been programmed to fake responses when remote servers send status checks, thus cutting down on the traffic on the WAN. See **denial-of-service attack**. See **network**.

spool—An acronym for simultaneous peripheral operations online. See **spooling**.

spool folder—The folder that "holds" files waiting to be printed.

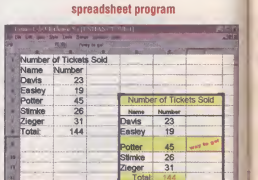
spooling—The queuing of print jobs all waiting for their turn to be printed. Printers do not print as quickly as computers operate. On networks, multiple users might send documents to the same printer. These documents are sent to a spooler, where they wait their turn to print. Spooling frees the computer's attention so the user can continue working while waiting for a document to print.

spot color—A printing technique where color is printed in layers. Each individual color is printed with its own ink as a separate layer. The printer keeps adding layers until all the colors have been printed. Inkjet printers use spot color.

spreadsheet—A worksheet consisting of rows and columns that manipulate and display numerical data. Computerized spreadsheets include built-in calculating tools to perform mathematical functions using the data in its cells. For example, rows and columns can be totaled or programmed to compute an average profit. As data is changed in each cell, the computer automatically makes new computations. Microsoft's Excel and Lotus are two of the most popular spreadsheet programs. See **spreadsheet program**.

spreadsheet program—A specific application designed to create spreadsheets. The user can define the relationships between the cells of data so alternating one cell makes a change in the row or column totals. The spreadsheet becomes not only a display

spreadsheet program



application, but a calculation tool. The user can immediately see how changing one value will affect the rest of the totals. Some spreadsheet programs include graph and chart capabilities.

sprocket feed—See pin feed.

SPS—See uninterruptible power supply.

SPX—See sequenced packet exchange.

SQL—See structured query language.

SRAM—See static RAM.

SSDD—See single-sided diskette.

SSE—Short for Streaming SIMD Extensions, a new technology included in Intel's Pentium III microprocessors. The Pentium III features a bigger instruction set than its predecessors. The new instructions speed applications that make floating-point calculations, especially in loops. The performance gains come from optimization of cache memory performance and SSE's ability to process four floating-point or integer values in a single instruction. Applications that benefit from SSE include streaming audio and video, 3-D video, scientific modeling, and computer assisted design (CAD), among others. Existing software will not run faster because of SSE, and programs have to be optimized for SSE to take advantage of its new instruction set. See Single Instruction Multiple Data. See instruction. See floating-point notation.

SSI—See small-scale integration.

SSP—See system support program.

standalone—A device or system that can perform its function independently. A non-network PC is an example of a standalone.

standard—A specific guideline that unifies a hardware or software product or a process. Standards are decided in one of two ways. A de facto standard has been accepted by the industry, usually because one company cornered most of the market in the initial stages of the product's market life. Alternatively, a standards board will collectively develop a new standard. Standards are good for end users because they encourage compatibility, allowing buyers a wider range of choices.

Standard Apple Numeric Environment (SANE)—A Macintosh graphic calculator and arithmetic feature.

Standard Generalized Markup Language (SGML)—A formatting language that allows the transfer of information between applications. SGML imbeds commands within the document, and an SGML-compatible application takes those commands and formats the document accordingly.

standby power system (SPS)—See uninterruptible power supply.

star network—A local-area network (LAN) with a star topology. See star topology.

star topology—A local-area network (LAN) design in which all peripheral systems are attached directly and exclusively to the main computer, called a hub, to which all communications are routed. A major disadvantage of this type of network is the danger that a hub malfunction will cause the entire network to go down. Compare to bus topology. Compare to ring topology.

start bit—A bit that signals the beginning of an asynchronous data transmission. See asynchronous transmission.

start/stop transmission—See asynchronous transmission.

startup—The process of getting a computer ready for operation. This includes internal checks and the loading of software, such as the operating system. See boot.

startup application—An application that is automatically launched whenever the computer is booted. Also refers to the Apple Macintosh boot-up program.

startup disk—A diskette used to initialize the computer's startup process. A startup diskette is often used if a virus is suspected in the main hard drive. The startup diskette bypasses the possibly corrupted boot-up file and provides a set of virus-free records that allow the user to clean up any files on the hard drive. See bootable disk.

StartUp folder—A special folder found in the Programs folder of the Windows 95 Start Menu. The StartUp folder contains the applications a user wants automatically launched when Windows 95 is started. Users can add or delete applications from the StartUp folder by navigating to the Start Menu folder inside the Windows folder.

StartUp group—A special program group in the Windows 3.x operating system that contains links to applications that will be automatically launched when Windows is started. Users can add or delete these links to customize their system.

startup ROM—The string of instructions for getting a system up and running that are stored in read-only memory (ROM) and executed when the computer is turned on. See read-only memory.

state—See status.

state-of-the-art—The latest cutting-edge technology. Often used to describe new computer technology.

statement—An individual line of instruction in a program

static allocation—A portion of memory that is set aside for an application's use at the application's startup. That portion of memory remains dedicated solely to that particular application throughout the application's use.

static memory—See static RAM.

static RAM (SRAM)—(Pronounced ess-ram.) A type of semiconductor memory that preserves stored information as long as there is enough power flow to keep the device running. Although SRAM can only hold one-fourth of the data a dynamic random-access memory (DRAM) chip holds, it is still effective because it does not need refreshing. Static RAM is quicker and more dependable, but also is more expensive, takes up more space, and uses more power than DRAM. Due to these characteristics, SRAM is never used as the main RAM storage facility, and is instead used for the more speed-critical parts of the computer, such as cache memory. Compare to dynamic RAM.

status—The information about the activity level of an aspect of the computer system such as a device or a program. For example, the flashing light on a diskette drive indicates that the status of the drive is active.

stepper motor—A motor that moves in small, consistent increments. Stepper motors are used to direct the motion of access arms on diskette drives. The access arm holds the read/write heads. This type of actuator motor is used primarily on older-model hard drives. Compare to voice coil.

stop bit—In asynchronous communications, a bit that follows each character to signal the end of that unit of transmission. See asynchronous transmission.

storage—The holding of information for later use. A computer has two basic types of storage: internal and external. Internal storage refers to information accessible and loaded into memory when the system is booted up. External storage refers to the computer's hard drive, diskette drives, and backup tape drives.

storage device—Any piece of computer hardware used to hold digitized information. There are two types of storage devices: primary and secondary. Primary storage devices, such as random-access memory (RAM), hold information for only a short period of time. This data usually is lost when a computer is shut down. Secondary storage devices, such as diskette drives, are a more long-term form of storage; they hold information until it is deleted or overwritten. See diskette. See random-access memory (RAM).

storage location—The identified location of a specific piece of information. When a computer stores a piece of data, it "places" it in a particular spot on the hard drive or diskette. The computer keeps track of each address and which information is stored there. See address.

storage media—See storage device.

store—To hold information for later use.

store-and-forward—A method of routing information to the correct network address. Used in routers and network switches. Data frames are received by the router or switch and held in the device's memory. The destination address is extracted, and the router or switch queries the destination address to see if it is valid. After the router or switch proves the address is valid, the stored network frames are sent on to their destination. See network. See switches.

streaming—Audio or video, transferred over a network, that plays dynamically as the content is downloaded. This gives an impression to the user similar to that of watching television or listening to the radio. To avoid interruptions due to network problems, a few seconds of streaming content is usually buffered on the receiving PC. Unlike sound clips or video files, streaming content is open-ended, with no set beginning or end. There are several formats for streaming audio and video, the most common being RealAudio, with Microsoft's NetShow making inroads. Streaming content is primarily used on the Internet, especially by radio stations.

streaming tape—A type of magnetic tape that flows through a tape drive's read/write head at a speed comparable to a central processing unit's (CPU's) ability to write information to it. See head.

string—Any series of characters, such as "AB" or "A357#2B."

stripe pitch—The distance, measured in millimeters, between two adjacent pixels on a computer monitor. The smaller the stripe pitch, the sharper a monitor's image. Stripe pitch is only used to describe the sharpness of displays that use aperture grills instead of the traditional shadow mask. Stripe pitch is not directly comparable to dot pitch, which measures the sharpness of shadow mask displays. See aperture grill. See dot pitch. See shadow mask.

stroke weight—The thickness of the lines that make up a character in a font.

structured query language (SQL)—(Pronounced sequel.) A sub-language in a database used to request information from that database. SQL can also be used to update and manage relational databases, as well as alter and secure data. While there is no official standard database language, SQL is the most common and therefore the de facto standard. It was developed by IBM for its mainframes, but nearly all database systems intended for client/server environments support it. Compare to query by example.

stub—A piece of computer code that either issues a remote procedure call (RPC) or serves as a placeholder. In the first instance, if a program calls the stub, the stub would pass along the information to the RPC—a program running on a remote server—and pass the results from the RPC back to the program. In the latter case, a stub is part of a program's code that sets aside space for a function or routine to be added to the program later. For example, if someone created a text editor and knew they were going to include a function that would convert files to Hypertext Markup Language (HTML) format in a later version of the program, they could place a stub in the program saying, "HTML converter not yet completed." The stub would not do anything, but the programmer could write the rest of the program as if that converter was there. If the program were to call the stub, a message would pop up and say "HTML converter not yet completed." See code. See remote procedure call.

stuff—The act of compressing a file. See file compression.

style sheet—A template used in both desktop publishing and Web page design that sets the default text style and page layout. Style sheets can define typeface, size, and color for several different styles (i.e., body text, headlines, captions, etc.). They may also specify layout attributes, such as margins, line spacing, the number of columns, amongst other things. Some style sheets include boilerplate content that needs to be applied to many similar pages. Style sheets are either included in the document or HTML file itself or are saved in a separate file whose location is specified in the document or HTML file. See boilerplate. See cascading style sheet.

stylus—A pen-shaped instrument used with graphics tablet or touch screen input devices to write or draw on the computer screen as on a sheet of paper.

subdirectory—A directory located within a larger directory. See directory.

subnotebook computer—A smaller, lighter version of the portable notebook computer. Subnotebooks are differentiated from notebooks by size and weight. The notebook is generally eight to 15 pounds, while the subnotebook is two to eight pounds. Compare to **portable computer**. See **notebook computer**.

subscript—A character printed at half the height of a character below the line of text.

subtractive primary colors—See **cyan-magenta-yellow**.

subwoofer—A speaker used to play the low frequency areas of the audio spectrum. Some computer speaker systems use a crossover circuit to separate low frequency notes and pass them on to a third speaker, the subwoofer. The rest of the spectrum is played on the other speakers.

super video graphics array (SVGA)—A set of video standards that provide a level of resolution one step above VGA (currently the minimum display standard). SVGA monitors and video cards are capable of displaying 16 million colors, but the number of colors actually displayed at once depends upon the video memory available on the computer. SVGA includes resolutions up to 1,280 pixels by 1,024 pixels. See **video graphics array**. See **video standards**.

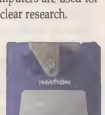
super-large-scale integration—A form of circuit construction with 50,000 to 100,000 circuit components on an integrated circuit.

Super-video (S-video)—A technology that improves video resolution. The technology is also known as Y/C video because it improves video by separating luminance (the symbol for which is Y) and color (C) values. Separating those two values prevents color bleeding and helps increase clarity and sharpness. In fact, S-video is at least twice as sharp as the "composite" standard used by most video devices. Many fine graphical details in games only become easily visible with S-video. S-video is best used on devices that use a television for a monitor, including computers, video games, and some video cameras and VCRs. S-video is not a good option, however, for computer monitors because its resolution is not as good as the red-green-blue (RGB) video—the current standard for computer monitors.

Super7 initiative—A new, Socket-7 platform, 100 megahertz (MHz) chipset that imports advanced graphics port (AGP) features and higher bus speeds, and provides up to 50% more bandwidth for accessing the Level 2 cache and main memory areas. See **chipset**. See **Socket 7**. See **Level 2 caching**.

supercomputer—A large computer capable of processing enormous amounts of data at high speeds. Supercomputers are used for complex jobs such as nuclear research.

SuperDisk—A trademark for drives that use LS-120 technology. LS-120 is a removable diskette format developed by Imation that stores 120 megabytes (MB) of data on a standard-size, 3.5-inch diskette. The drives are backward-compatible with older diskettes, enabling a user to replace a standard diskette drive while still maintaining access to data on the older diskettes. LS-120 drives (the LS stands for laser servo) use a laser to position the read/write head precisely over the correct track on the diskette. This technique allows LS-120 media to have a per-inch track density of 2,490, compared to 135 for the older diskettes. See **backward compatible**. See **diskette**. See **head**.



SuperDisk

SuperDrive—A high-density diskette drive used in Apple Macintosh computers.

superscalar—A chip architecture that provides the microprocessor with the capability to process more than one instruction in every clock cycle.

superscript—A normal-sized character printed at half the height of a character above the line of text.

supersite—See **portal**.

supertwist—A technology that enhances liquid-crystal display (LCD) screens by twisting liquid molecules to add contrast to the image of the text and graphics on the screen. See **liquid-crystal display**. See **supertwisted nematic**.

supertwisted nematic (STN)—A type of liquid-crystal display (LCD) used in portable computers. STN builds on the twisted nematic (TN) method, which twists liquid molecules 90 degrees between polarizers to achieve a black-on-gray display. Supertwisted nematic screens twist the molecules from 180 to 270 degrees to achieve a sharper contrast, as well as color displays. See **liquid-crystal display**.

support—See **customer support**.

surface modeling—A computer-aided design (CAD) program technique where an object on-screen can be manipulated as a solid object. The object can be turned to view different sides and angles, zoomed in or out, or made transparent to view what the structure would resemble inside. See **computer-aided design**.

surface-mount technology (SMT)—A method of attaching a computer chip to a

Integrated Circuits

Type	Number Of Elements
small-scale	less than 10
medium-scale	10-100
large-scale	100-5,000
very-large-scale	5,000-50,000
super-large-scale	50,000-100,000
ultra-large-scale	more than 100,000

super-large-scale integration

board by soldering the chip onto the surface of the board instead of into a specially carved hole. This is something that is done in the factory to keep the chip secure and save time and space.

surge—A sudden jump in the voltage of an electrical current that can cause serious damage to unprotected computer equipment.

surge protector—A plug-in device that protects electronics from high-voltage surges or spikes in electrical current. Surge protectors are better than nothing, but they are not a guarantee against electrical problems. Users should still power down and unplug equipment during an electrical storm. Also called a surge suppressor.

surge protector

surge suppressor—See surge protector.

suspend—To temporarily place a function or application on hold without shutting it down. Users can then pick up the application where they left off.

SVGA—See super video graphics array.

swap file—A file on a hard drive used as virtual memory. Data from the least-frequently used parts of a computer's physical random-access memory (RAM) are put into the swap file until they are needed again. When needed, the data is swapped back into the physical RAM, trading places with other little-used parts of the physical RAM. See **random-access memory**. See **virtual memory**.

swim—A slight, slow, wandering movement of objects on-screen that are supposed to remain fixed.

switch—A piece of a physical circuitry component that governs signal flow. Having the switch open allows the signal to flow through, while keeping the switch closed stops the flow and breaks the circuit connection.

SXGA—Short for Super XGA, a standard for a screen resolution of 1280x1024 pixels. See **extended graphics array (XGA)**. See **resolution**.

symbol font—A specialized font composed of non-alphabetic characters, graphics, or both.

symbolic operator—In program code, a symbol that stands for an operator. These are in effect shorthand notations for operators. The AND operator, for example, can be expressed by the symbolic operator "&" instead of typing out AND. Symbolic operators are very handy for programmers and for those performing complex searches who would otherwise have to type out many operators. See **Boolean**. See **operators**.

synchronization—The coordination of events, operations, or components internally within a system or between multiple systems. Also called clocking.

synchronous data link control (SDLC)—A data transmission protocol used by networks using Systems Network Architecture (a communications format, advanced by IBM, used on local-area networks [LANs] to allow multiple systems access to centralized data). SDLC defines the format used to transmit the data traveling over network lines.

Synchronous Dynamic random-access memory (SDRAM)—A type of memory that can run at much higher speeds than conventional Dynamic RAM (DRAM). The speed increase is achieved by synchronizing the memory with the computer's internal clock, allowing for speeds of up to 100 megahertz (MHz), at least twice as fast as some types of DRAM and up to three times faster than others. SDRAM has already been bypassed by central processing unit (CPU) speeds, now often in excess of 300MHz. SDRAM II doubles the speed of SDRAM by accessing memory on both the rising and falling edge of the computer's clock instead of just once per cycle. In musical terms, it is akin to playing a note on the up and downbeat. Even SDRAM will be surpassed by newer DRAM technologies, which can range from 600MHz to 1600MHz. Compare to **Rambus Dynamic random-access memory**. Compare to **SyncLink Dynamic random-access memory**. See **random-access memory**.

synchronous transmission—A communication transmission in which data bits are transmitted at regular, structured intervals. Communication within a computer system is generally synchronous because it is regulated by the microprocessor; communication between a computer and a device, such as a printer or a modem, is asynchronous because data bits do not need to wait for a certain event or time to be transmitted. Synchronous transmissions within the computer are coordinated by the unit's internal clock. Compare to **asynchronous transmission**.

SyncLink Dynamic random-access memory (SLDRAM)—A form of dynamic random-access memory (DRAM) competing with Rambus Dynamic RAM (RDRAM) to be the successor to the current memory standard, Synchronous Dynamic RAM (SDRAM). SLDRAM is an open standard, meaning the specifications are free for anyone to use, but it has not gained much of a following in the computer industry. Most manufacturers are betting their money on RDRAM, which at 600 megahertz (MHz) to 800MHz is faster than SLDRAM's 400MHz. With Intel having already adopted RDRAM as the standard that will be used by its next generation of motherboards and RDRAM's speed advantage, the viability of the SLDRAM standard is questionable. Compare to **Rambus Dynamic random-access memory**. See **random-access memory**.

synonym—A pair of keys that can be used to perform the same function.

syntax error—An error due to improper use of the programming language. The error is recognized when the program runs, and an error message is displayed.

synthesizer—A peripheral device that creates analog sound from the computerized digital instructions. An analog sound is the signal human ears are able to receive and interpret. Digitized sound is a sound

translated into a form that a computer can understand and store.

sysop—See system operator.

system—The integration of hardware and software to create a machine, such as a computer, that can perform work. System can refer to a single computer or a system of multiple computers. Also can mean an operating system.

System 7—A Macintosh operating system that contains virtual memory, multitasking, hotlinks, and TrueType fonts.

system administrator—See system operator.

system board—See motherboard.

system clock—The main clock that coordinates all timing applications. See clock.

system conversion—See conversion.

system development—The process of designing, building, and completing a new computing system. Can apply to hardware and software manufacturing as well as to the setup of new processes.

system diskette—A flexible diskette that holds operating system information. A system diskette can help the boot system in case of a serious system error.

system error—A software malfunction that makes an operating system inoperable. See operating system.

system failure—An error that results from a problem with either hardware or software and causes the system to stop functioning. See operating system.

system fault tolerant—The degree to which problems might occur before the system will stop functioning normally. See operating system.

system file—A file used by an operating system or control program. See operating system.

system font—The font an operating system uses as its text for menus and error and confirmation messages. See operating system.

system image—The programs controlling the text and graphics that appear on the screen. See image.

system operator—The person in charge of a multiuser system. Generally the administrator is in charge of programming, support, security, and storage.

system prompt—See prompt.

system software—Software that manages a computer's hardware, graphical user interface (GUI), and operating environment, and tells the computer how to perform its daily functions. System software also teaches a PC how to communicate with the user.

system support program (SSP)—An IBM multiuser, multitasking operating system. SSP is the main control program for System/34 and System/36, minicomputers developed in the late 1970s.

system timer—See system clock.

system tray—In Windows 95/98, the far right end of the Taskbar, in the bottom right corner of the screen. The system tray displays the time as well as the status of various Windows functions (i.e., Dial-Up Networking). You can also change some system configurations via the system tray such as the volume. Various software programs, from virus scanners to RealPlayer, might place an icon in the system tray that allows you to conveniently launch the program and change the program's settings.

systems analysis—Designing a computer system based upon tasks, personnel, and environment.

systems analyst—A designer of computer systems for specific tasks or environments. Systems analysts must consider how end users will use the system before they can design a new unit or add to an existing one. System analysts often can be likened to efficiency experts in that they examine a system to see how it is currently being used and how it is falling short of user needs, demands, and expectations. The analyst then takes this information and creates an effective system that will let end users complete their tasks quickly and efficiently and with fewer problems. After the system has been created, the analyst will supervise its implementation.

systems integration—Building a system from compatible components from different manufacturers.

Systems Management Server (SMS)—A set of tools for administering large networks of PCs in corporate settings. These tools help system administrators manage dozens, sometimes hundreds, of machines from a central location. SMS was developed by Microsoft Corp. and can be used with computers running DOS, Windows, and Macintosh operating systems. SMS allows network administrators to detect every machine on the network, inventory the software and hardware installed on each machine, and store that information in a central database. Administrators can use that information to plan hardware and software upgrades. SMS can also be used to install desktop applications from a central location, and installations can be performed after hours when network traffic is light. Remote control of desktop PCs (except Macs) also is possible, enabling troubleshooting from remote locations.

systems network architecture (SNA)—A communications format, advanced by IBM, used on local-area networks (LANs) to allow multiple systems access to centralized data.

systems programming language (SPL)—The assembly language for the HP 3000 computer system.

T—See tera.

T1—A type of data connection able to transmit a digital signal at 1.544 megabits per second (Mbps). T1 lines often are used to link large computer networks together, such as those that make up the Internet. Although T1 lines can support video, it is not TV-quality, full-motion video. Compare to **T3**.

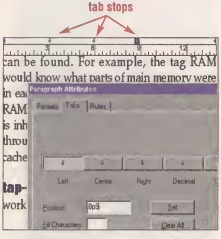
T3—A type of connection from a computer to the Internet, transmitting a digital signal at 44.746 megabits per second (Mbps). Not yet widely used, the T3 connection is more

than fast enough to support data transfers necessary for full-screen, full-motion video.

TA—See **terminal adapter (TA)**.

tab—An indention at the beginning of a line to signify a new paragraph in a document. Usually about five spaces, tabs primarily are used to ensure equal spacing from line to line. There also is a tab called the write-protect tab on diskettes. When in a certain position, this tab prevents data on the diskette from being overwritten or erased. See **3.5-inch diskette**. See **5.25-inch diskette**.

tab character—A text character that directs a word processing program or printer to move the cursor or printer head to the next tab stop.



TAB key—A keyboard key that inserts a tab character or advances the cursor to other tab settings on a line. This key also can be used to move among data fields.

tab stop—A place on a text line where the cursor goes when the TAB key is depressed. In word-processing documents, tab stops usually are placed at regular intervals across the line, but can be set wherever the user wants them.

Color	Prompt & Text	Background
Black	30	40
Red	31	41
Green	32	42
Yellow	33	43
Blue	34	44
Magenta	35	45
Cyan	36	46
White	37	47

table

table—An arrangement of information in rows and columns that makes comparing and contrasting easier. For example, charts in newspapers and magazines often are presented in table format.

tablet—See **graphics tablet**.

tag—A code or symbol that provides formatting instructions. See **Hyper Text Markup Language tag**.

tag random-access memory (tag RAM)—A part of static random-access memory (RAM)—typically in the Level 2 (L2) cache—that lists the contents of the static RAM and where they can be found. For example, the tag RAM would know what parts of main memory were in each line of the L2 cache. Checking the tag RAM for the location of items in the L2 cache is inherently faster than searching line-by-line through the cache until it's found. See **Level 2 caching (L2)**.

tagged image file format (TIFF)—(Pronounced tiff.) A common way to store bit-mapped graphic images on both PCs and Macintosh computers. TIFF is a platform-independent format, which means a TIFF image created on a PC can be viewed on a Macintosh, and vice versa. Bit-map files, on the other hand, are a graphic format for the Windows environment. This format was specifically designed for scanned images and is commonly used for that purpose. It also can be used in some applications to save images created on a computer. TIFF graphics can be color, grayscale, or black and white. The file extension for TIFF images is .TIF. See **bit-mapped graphics**.

tap—An access point onto a local-area network (LAN).

tape—A strip of magnetically coated plastic that stores data. Tape storage is less expensive and has a higher storage capacity than diskette storage, but accessing data on it is much slower because information is stored sequentially, and the tape drive must be forwarded or reversed to a specific point on the tape to retrieve data. This storage method used to be popular as a main storage device, but it now primarily is used for backing up files.

tape backup—A backup operation that makes copies of files from the hard drive, often for archiving purposes, and stores them on magnetic tape.

tape cartridge—A hard plastic case that holds magnetic computer tape.

tape drive—A device for reading from and recording to magnetic tape. Because of their higher capacity and slower access compared to diskettes, tapes are used most often for backing up files. See **tape**.

TAPI—See **telephony applications programming interface (TAPI)**.

target—The destination file or device where source data is moved, copied, or stored, whether transferred internally or over communication lines. For example, if a user wishes to download a file from the A: drive into the C: drive, the A: drive is the source, and the C: drive is the destination and therefore the target. The target can also be the audience for whom a certain product is designed.

task—One of several programs or subprograms that runs in a computer's multitasking environment. Each program is assigned a task number. For example, if you're running Windows and you start Paintbrush, that program is assigned a task number and is one of the tasks Windows is running at that point.

task list—A menu that appears in Windows 3.1 when users press the CTRL-ESC key combination, which provides a list of open applications from which to choose. In Windows 95, that key combination opens the Start menu. See **Taskbar**.

task switcher—See **task switching**.

task switching—To change from one active task running under an operating system to another without losing your place in the first task. Task switching differs from multitasking in that programs switched to the background do not continue to process information but can be brought back to the foreground at any time. For example, if you are working in a word processor and switch to another program, when you return to the word processor, the cursor will be in the same place it was before switching. Compare to **multitasking**.

Taskbar (at bottom of screen)

Taskbar—A bar at the bottom of the screen that displays open applications and aids in task switching in Windows 95/98. The Taskbar includes the Start button, which is the main tool on the Windows 95/98 Desktop. See **task list**.

TB—See **terabyte**.

TCP—See **Transmission Control Protocol/ Internet Protocol (TCP/IP)**.

TCP/IP—See **Transmission Control Protocol/ Internet Protocol (TCP/IP)**.

TCP/IP stack—See **Transmission Control Protocol/ Internet Protocol (TCP/IP)**.

tear-off menu—A menu that can be separated from the application window in a graphical user interface (GUI) and moved to another location on the screen. This is done by clicking the menu, dragging it, and then releasing the mouse button when the user has positioned the menu in the desired location. Compare to **pop-up menu**.

technical support—See **customer support**.

technobabble—A complicated and almost incomprehensible language used to describe or define an aspect of technology. Technobabble is the computer world's version of "legalese."

Technology Without An Interesting Name (TWAIN)—(Pronounced twain; rhymes with train.) A standard interface for scanning equipment. Most scanners come with a TWAIN driver, which allows scanners to work with any software that supports TWAIN. These drivers often allow graphics programs to automatically activate a scanner or other input device.

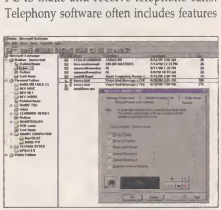
telecommunications—Transmitting data electronically over a communications line. Telecommunications includes using a modem to send a file, using a fax machine to send a document, and using a modem to access a bulletin board service (BBS) or online service.

telecommuting—To work at home and communicate with an office via telecommunications lines. Telecommuting is increasingly popular as the technology that allows workers to telecommute effectively becomes available. Many companies allow workers to telecommute a few days a week, but require them to work in the office much of the time as well. There are several benefits to telecommuting; increased productivity and time savings are the most commonly cited benefits for companies, while comfort and convenience rank high among telecommuters. Drawbacks such as distractions and lessened communication with co-workers, however, do exist.

teleconferencing—To hold a conference or meeting over telephone lines where users in separate locations can all hear one another speak. Computer, audio, and sometimes video equipment is linked to the telephone system to enable these conferences to take place. When video is added to the mix, the resulting communication is referred to as videoconferencing. Compare to **videoconferencing**.

telecopying—See **fax**.

telephony—Technology that lets users use a PC to make and receive telephone calls. Telephony software often includes features



telephony

such as voice mail, auto dialing, and on-screen messaging. Sounds are converted into electrical signals as they are transmitted to another location where they are converted back to sound. Telephony includes communications such as teleconferencing and facsimile (fax). Telephony also lets you have a universal inbox, where E-mail, fax, and voice mail messages are all accessible from your computer.

Telephony Applications Programming Interface (TAPI)—A standard that allows PC support of a broad range of communications devices. It also allows computers to interface with telephone equipment.

teleprinter—See **teletypewriter**.

teleprocessing—To use a computer equipped with communications software to access distant computers and files. A term coined by IBM. Also called remote control computing.

teletypewriter (TTY)—A communications setup that has a keyboard and a printer. When a key is pressed on keyboard, a signal is sent to the printer and the appropriate character is printed. Teletypewriters are the middle step between a typewriter and a complete system of keyboard, monitor, and printer, where a video image of the characters is created from the keystroke. Also called teleprinter.

Telnet—Terminal emulation in which a user is connected to a remote host using an Internet account as if the user were directly connected to the host. For example, typing telnet hostname connects a user to a host named "hostname." After a prompt for a user name and password, the session continues as if the user was at a terminal connected to the host, though the user is actually connected to another site, using the Internet to connect to the host. See **terminal emulation**.

template—A ready-to-use, permanent document setup with basic layout, formatting

commands, and formulas. Users can enter information to create individualized reports, letters, and other documents.

temporary directory (TEMP directory)—A specific directory on a hard drive, usually named "TEMP," used as a storage space for temporary files. See **temporary file**.

temporary file—A file designed to store information while a user is working with that file. Temporary files are retrieved from storage by an application and manipulated by the user, leaving the original file intact until the user saves it under the original file name. Temp files are created automatically by applications and usually are deleted automatically when they are no longer needed. The user can delete them, however, to recover disk space. Also called a temp file.

tera (T)—A prefix that stands for 1 trillion.

terabyte (TB)—A unit used to measure a storage device's capacity. One terabyte equals 1,099,511,627,776 (2 to the 40th power) bytes. It is commonly referred to as 1 trillion bytes.

terminal—A set of hardware normally composed of a keyboard and a monitor that lets users communicate with the internal central processing unit (CPU), which is the "brain" of the computer.

Terminal—A communications applet in Windows that enables a computer to connect to and exchange information with other computers. Terminal is found in the Accessories program group.

terminal adapter (TA)—A device that lets a PC interface with another computer via an Integrated Services Digital Network (ISDN) phone line. It is the equivalent of a modem for an ISDN communications line. See **Integrated Services Digital Network (ISDN)**.

terminal emulation—A technique in which a computer acts like a type of terminal other than its own by using special software to communicate with another computer, such as a mainframe. For example, if you have a PC that needs a specific kind of dumb terminal to interact with a specific mainframe, terminal emulation can allow the computer to emulate the needed type of terminal, allowing it to communicate successfully with the mainframe. Terminal emulation often is used to connect to bulletin board systems and generally is a text-only means of interaction with the other computer.

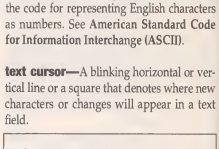
terminate-and-stay-resident program (TSR)—A program that remains in memory until it is needed, then performs some function. TSRs often load into a computer's memory automatically at startup. Thereafter, they may show no outward sign of their existence until they are called into action on command from another application or the user. In DOS, TSRs frequently activate whenever a certain combination of keys is pressed. Many types of screen savers are examples of TSRs. The user only sees they are running when a specific event (in this case a length of no user activity) occurs. The characteristics of TSRs make them useful for many situations, but they also eat up valuable memory space that cannot be used by other applications. In older computers that have little memory to begin with, a TSR or two can start to seriously cut down performance.

terminator—On the last device of a chain or network, a resistor that signals the end of the chain and prevents signals from reflecting back down the chain once they reach the end. Terminators are used on 10Base-2 Ethernet networks, LocalTalk networks, and Small Computer System Interface (SCSI) chains. Networks and chains that require a terminator will not work properly without one. 10Base-2 and LocalTalk networks require terminators on each end. SCSI chains need only one terminator, at the end of the chain. On SCSI chains and 10Base-2 transceivers, the terminators can be internal or external. External terminators are small connectors that clip onto the last open port. Internal terminators are contained in the SCSI devices or 10Base-2 transceivers themselves. Some devices are self-terminating; if the device senses it's the last in the chain, it will turn on an internal terminator. On some devices with internal terminators, a user must manually activate the terminator by flipping a switch.

Texas Instruments Graphics Architecture (TIGA)—A graphics specification developed by Texas Instruments that doesn't require a specific resolution or a set amount of colors.

text—Alphanumeric data that a computer stores as American Standard Code for Information Interchange (ASCII) characters, the code for representing English characters as numbers. See **American Standard Code for Information Interchange (ASCII)**.

text cursor—A blinking horizontal or vertical line or a square that denotes where new characters or changes will appear in a text field.



text editing—See **edit mode**.

text editor—See **editor**.

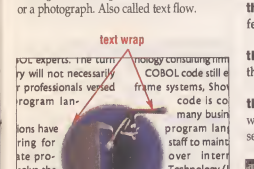
text file—A data file that holds only text characters with no added formatting. Features such as bold, underlining, italics, special spacing, columns, and other attributes associated with most word processing documents cannot be saved into a text file. About the only thing that a text file holds are the words themselves, along with spaces and punctuation. Because text files are so simple, they take up little storage space, however, and they can be read by a wide variety of applications on many types of computers. In DOS and Windows, many word processors can save documents as text file documents with the .TXT file extension. Existing documents in other formats, such as Microsoft Word's .DOC, can be saved as text files at the expense of losing their formatting. Such conversions leave behind only the plain text.

text flow—See **text wrap**.

Text mode—A display mode where the screen is divided into rows and columns of boxes, in which only Alphanumeric characters are shown. Also called character mode or alphanumeric mode. In addition, text mode can describe the state of a computer when it displays only text. A computer running DOS is usually in text mode, unless it is running a program that includes graphic elements. On the other hand, a computer running Windows is in graphics mode, because

it is running a graphical user interface (GUI) and requires graphics. See **graphics mode**.

text wrap—A word processing feature that allows the user to let text flow around the edges of an image, such as an illustration or a photograph. Also called text flow.



text-based interface—See **character-based interface**.

text-only—A display mode that shows text without any graphics. In a World Wide Web browser (a program used to navigate the World Wide Web), text-only mode saves time because the browser does not have to download graphics.

texture mapping—To give surface texture to an image in a computer graphics program.

TFT—See **thin film transistor (TFT)**.

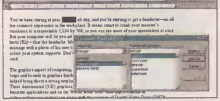
thermal printer—A printer that uses heated pins to "burn" images onto heat-sensitive paper. The pins are electrically heated and brought into contact with the specially treated paper easily, instead of with great impact. The coating on the paper discolors when heated in this way. These printers, used in calculators and many fax machines, are inexpensive, but produce low-quality, low-resolution print. They are, however, fast and quiet as they print.

thermal transfer printer—A printer that uses a heat element to transfer images from a thermal wax ribbon to the paper. Pins like those in a plain thermal printer apply heat to a colored wax ribbon, which melts onto the paper, cools, and resolidifies to create the image. This type of printer is more expensive than an inkjet printer, but less expensive than many laser printers. The cost per page, however, is fairly high. Thermal transfer printers can generate nearly photo-realistic output.

thermal wax printer—See **thermal transfer printer**.

thermal wax-transfer printer—See **thermal transfer printer**.

thesaurus—A tool included with some word processors that provides synonyms for selected words on command.



thesaurus

thick Ethernet—A type of Ethernet cable that is one centimeter in diameter and used to connect machines up to 3,300 feet apart. Compare to **thin Ethernet**. See **Ethernet**.

thimble printer—A printer that uses a typing element called a thimble, which contains a full set of characters, to press images on paper through a ribbon. The result is the same as with a daisywheel printer, which has the characters on spokes of a wheel, and is nearly indistinguishable from a typewriter product. Thimble printers are cheap, but slow, compared to laser printers. Popular before inkjet and laser printers became affordable alternatives, thimble printers now are used much less often.

thin client—A type of computer that relies on a server to do most, if not all, of its processing. Thin clients typically control only the keyboard and monitor. One kind of thin client, a Windows terminal, runs Windows programs on a central Windows NT server. The individual terminals merely forward keyboard and mouse input to the NT server and display the programs running on the server on a monitor. Thin clients are best suited at workstations where minimal hardware requirements, such as data input, word processing, or other office tasks, are needed. See **NetPC**. See **network computer (NC)**. See **Windows terminal**.

thin Ethernet—A type of Ethernet cable that is 5 millimeters in diameter and used to connect machines up to 1,000 feet apart. Compare to **thick Ethernet**. See **Ethernet**.

thin film transistor (TFT)—Sometimes called active-matrix liquid-crystal displays (LCDs). A type of flat-panel PC screen used on portable computers. Each pixel is controlled by between one and four transistors, making TFT screens faster, brighter, and more colorful than passive-matrix screens, which use a grid of transistors to turn rows and columns of pixels on and off. TFT provides the best resolution of any flat-panel technique, but is also the most expensive technology. See **active-matrix display**. See **liquid-crystal display (LCD)**.

third party—A company other than the original manufacturer who sells hardware, software, and even books for a product, such as a computer. For example, there are many third-party companies that make peripherals for IBM computers.

thrashing—When a computer using virtual memory is constantly swapping data back and forth between memory and the hard drive and getting little else done. This is a sign that there's not enough memory available for all of the programs the computer is running. If thrashing occurs regularly, users need to open fewer programs at once or install more memory. See **swap file**.

thread—A message and its responses in a newsgroup or mailing list. A thread is a conversation of sorts as people continue to add responses to previous responses. Thread also can refer to a small, independent set of operations belonging to a larger program being executed.

threading—See **multithreading**.

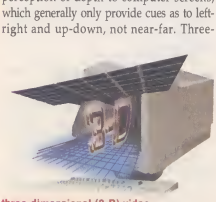
three-dimensional (3-D)—A visual classification indicating that an object has or appears to have depth of field. In computers, 3-D video and audio devices do not necessarily offer three dimensions, but they usually have greater depth and richer output. A 3-D audio device uses psycho-acoustic technology

to "trick" the brain into believing sound is coming from all directions rather than from two speakers. 3-D video cards offer better graphics by using fast, built-in hardware to do certain computing tasks rather than software to perform some graphics calculations. The result is a more fluid image with enhanced colors.

three-dimensional (3-D) audio—Audio that seems to come from all directions, including above and below the listener. Most of today's computers and stereos only reproduce sound in two dimensions—right or left and near or far. They can't reproduce the sensation of sound coming from above or below you. Surround Sound gives the impression of hearing sound all around you (instead of right in front of you, where the speakers are), but they can't reproduce the up-down effect of 3-D Audio. Besides the obvious benefits of richer, fuller-sounding music and movie soundtracks, 3-D audio may also prove useful in fields such as teleconferencing, where it can be difficult to keep track of all the participants' voices. Three-dimensional sound is especially popular on PCs with speakers placed closely together, which offer poor channel separation.

3-D audio

three-dimensional (3-D) video—Generating images in a 3-D perspective on a two-dimensional (2-D) space, namely a computer screen. Specifically, 3-D video adds the perception of depth to computer screens, which generally only provide cues as to left-right and up-down, not near-far. Three-dimensional graphics can also show shadows and layers. With layers, one object is perceived as partially obscuring another object behind it, with the amount of obscurity changing depending on your "position" relative to the objects. The proliferation of games that feature travel through maze-like hallways has spurred development of 3-D graphics and video. Rendering 3-D images on computers was once prohibitively slow, but today's faster computers and graphic accelerator cards can render images fast enough to be used in live-action games, and the quality of the 3-D renderings continues to improve.



three-dimensional (3-D) video

throughput—The number of useful data bits transmitted each second by a modem or processed by a CPU, usually measured in bits per second (bps). Throughput speed often is higher than data transfer speed because of file compression. For example, if a 10 kilobytes (KB) file is compressed to 5KB and then transmitted through a modem in 1 second, the data transfer speed is five kilobytes per second (KBps) and the throughput speed is 10KBps. See **bits per second (bps)**. See **data transfer rate**. See **file compression**.

thumbnail—A smaller version of a graphic or document page that takes up less space on-screen to allow multiple images to be viewed simultaneously. These smaller images also are faster to load than full-size images. On the Web, a thumbnail graphic can sometimes be clicked to begin the automatic loading of the full-sized image.

thumbnails

TIFF—See **tagged image file format (TIFF)**.

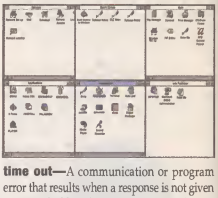
TIGA—See **Texas Instruments Graphics Architecture (TIGA)**.

tile—See **tiling**.

tiled windows—See **tiling**.

tiling—A method of arranging open windows so none overlap and all are visible. The Tile command is located in the Windows 3.x Program Manager Window menu. In Windows 95, you can tile all open windows by right-clicking an empty area on the Taskbar and choosing either Tile Horizontally or Tile Vertically.

tiling



time out—A communication or program error that results when a response is not given in a specified length of time. For example, you can be disconnected (sometimes called "kicked off") from an online service if you do nothing for a certain period of time. Some programs let you choose the length of time after which the program times out, so if you walk away and accidentally leave the program open, it won't keep running indefinitely.

time-sharing—To give multiple users access to a system at the same time. In a time-sharing computer system, a computer gives users its processing time one at a time in small portions so it appears the activity is happening at exactly the same time. This is similar to multitasking, but instead of one user and multiple processes, time-sharing involves multiple users. Most mainframes and minicomputers are time-share computers; most PCs are not. See **multi-user system**.

time-slice—The length of time each user gets on a multiuser system, or the length of time each segment of a program gets in multitasking.

title bar—The bar located along the top of a window or dialog box that displays the application's name. In Windows 3.x, the Control menu box, minimize button, and maximize button are located on either side of the title bar. In Windows 95, the title bar includes the minimize button, the maximize button, and the close button.

TOF—See **top-of-file (TOF)**.

toggle—To switch between settings, such as on and off. Also can mean the actual switch that controls these settings. For example, in Microsoft Word, the buttons controlling the switches for bold, italic, and underlined text are toggle switches, because each of those text characterlstics is either on or off when the buttons are clicked

token—A special piece of data passed from computer to computer in a token-ring network. Possession of the token grants a computer permission to "speak" to the network. Data is added to the token and it continues its journey around the ring to the destination computer. Because each computer must wait for the token before transmitting data, the network is not garbled with the noise of multiple computers attempting to talk at the same time. See **token-ring network**.

token bus network—Similar to a token-ring network in that a computer on the network must have possession of a token before it can transmit data. Rather than a physical ring defined by cabling, however, the token bus network is connected by a logical ring derived from network addresses. When the token reaches the last address, it is passed back to the first address. See **token ring network**.

token passing—A network control protocol in which a special pattern of bits called a token grants the right of a computer to send a message. It is analogous to a relay race. Each runner must receive the baton before running. Each computer in the network has to wait for the token before it can send its message. Compare to **carrier sense multiple access/collision detection**.

Token Ring—A specialized type of token-ring network developed by IBM that can connect up to 260 computers and facilitates data speeds up to four megabytes per second (MBps). BM that can connect up to 260 computers and facilitates data speeds up to four megabytes per second (MBps). IBM's Token Ring system features clusters of eight computers each that connect to the ring rather than each computer connecting to the ring on its own. A device called a Multistation Access Unit (MSAU) is located at each point where a cluster joins the ring. See **token**. See **token passing**. See **token-ring network**.

token-ring network—A type of network where computers are connected to one another in the shape of a ring. Computers gain permission to send data out on the network whenever a special piece of data called the token passes their location. As the token makes its way around the network, the different computers take their turns "speaking." In this way, no two computers attempt to transmit data at the same time over the same communications pathways. See **token**.

toner cartridge (being placed in printer)

toner—A dry, powdery pigment used by laser printers and copy machines to form images on paper. Toner is fused to paper with heat. See **laser printer**.

toolbar

toner cartridge—A removable container that holds toner for a laser printer, and which can be thrown away when empty. Some toner cartridges contain only the toner, while others include the photosensitive drum, making it less likely that someone will touch the drum and damage or mark up its surface.

toolbar—A row of boxes, often at the top of an application window, which control various functions of the software. The boxes often contain images that correspond with the function they control. In Microsoft Word, for example, the box that controls the print function contains an icon of a printer inside it. In most programs, toolbars can be turned on and off and often can be personalized with controls specific to an individual user's needs.

top-level domain—The last part of an Internet address, used to specify what kind of organization owns the address and in which country the organization is based. For example, for the address http//www.smartcomputing .com, ".com" is the top-level domain. Top-level domains are used to signify what kind of company or organization networks belong to. For-profit companies are signified by ".com." Others include ".org" (non-profit organizations), ".edu" (educational institutions), ".net" (network providers, especially Internet service providers), ".gov" (government agencies or departments), and ".mil" (military branches, agencies, or departments.) These domains can only be used by companies and organizations based in the United States. Organizations in other countries use addresses that end with their country's top-level domain. For example, all German Internet addresses must end with Germany's top-level domain, ".de." See **domain, universal resource locator**.

top-of-file (TOF)—The starting point of a file, generally accompanied by a character that indicates the document's beginning and informs the user that no information is missing. See **character**.

topology—The physical configuration of a network that determines how the network's computers are connected. Common configurations include the bus, star, and ring.

TOPS—See **transparent operating system (TOPS)**.

touch pad

touch pad—An input device for some portable computers. Moving an object, such as a pen or a finger, across the touch pad moves a pointer on the screen; tapping one's finger on the pad is the same as clicking a mouse button. Also called a pressure-sensitive tablet or touch-sensitive tablet.

touch screen—A type of monitor with a sensitive panel directly on the screen that registers the touch of a finger as input.

touch screen

Some, instead of being touch-sensitive, use beams across the screen to create a grid, which is interrupted by the presence of a finger near the screen. See monitor.

touch tablet—See graphics tablet.

touch-sensitive tablet—See touch pad.

tower—See tower model.

tower case—The upright case that holds and protects tower model computers. See tower model.

tower case

tower configuration—See tower model.

tower model—A housing method where the components of a computer are stacked vertically in an upright case. This is opposite of the more traditional desktop model and allows heat to rise and escape more easily. Depending upon the arrangement of your computer, it may either save you desktop space, or take up more space if you would have stacked your monitor on top of the case. The extra space in a tower model also allows for easier installation of additional components. Compare to desktop computer. See tower case.

TPI—See tracks per inch (TPI).

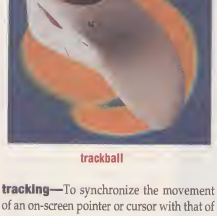
track—A data storage ring on a diskette or hard drive. A double-density (DD) diskette contains 80 concentric tracks, and a high-density (HD) diskette has 160. Tracks are recorded onto a diskette by an operating system during a diskette format and can be further broken down into sectors. See data. See sector. See storage.

track density—See tracks per inch (TPI).

track pitch—The distance between two tracks on a surface. In computing, it affects the tracks per inch (TPI) or the density of tracks on a diskette. See tracks per inch (TPI).

track-at-once—A method for writing data to a CD-Recordable (CD-R) one track at a time. Each time a track is written to the disc, two "run-out" blocks are written to mark the end of the track. This allows CD-R drives to stop and start recording at will and to easily pick up where they left off. If there is not enough data to fill a CD-R, more can be written later until it is full. If a CD-R is written to in the disc-at-once format, on the other hand, once the disc is written to, it can never be written to again. Compare to disc-at-once. See block. See CD-recordable drive (CD-R drive). See compact disc. See track.

trackball—A type of input device that looks like an upside-down mouse. The on-screen pointer is moved by the trackball with a thumb or finger. A trackball requires less arm and wrist motion than using a mouse. It also is a good choice for a pointing device on a portable system because it doesn't require desk space.



trackball

tracking—To synchronize the movement of an on-screen pointer or cursor with that of an input device such as a mouse.

tracking speed—The rate at which a mouse (or other input device) pointer travels across a computer screen. The tracking speed often can be adjusted relative to how fast you move the mouse, so the speed at which the pointer moves on your screen may not be the same speed at which you are moving the mouse. .

tracks per inch (TPI)—The number of tracks that will fit in a given area on a diskette. The higher the TPI, the more data a diskette can hold.

tractor feed—See pin feed.

traffic—How much activity is taking place on a communications system. Too many users on a network will lead to more traffic than the system was designed to carry, or a kind of traffic jam. Overloaded networks will sometimes malfunction, so network administrators work to control traffic.

trailer—The last part of a data transmission usually containing error-correction information that confirms whether the transmission made it through intact. Compare to header.

transaction log—See change file.

transaction processing—Dependent upon user input. After a user enters a request, or transaction, the computer will immediately respond. Compare to batch processing.

transceiver—A transmitter/receiver that can send and accept information. For example, a modem or other device that provides an input/output connection to the Internet or a local-area network (LAN).

transducer—A mechanism for transforming energy. For example, transducers in sonar transmitters change electricity into sound waves.

transfer—Transmitting data from point A to point B, whether the points are on a communications link or between components on a computer system.

Transfer Control Protocol/Internet Protocol—See Transmission Control Protocol/ Internet Protocol (TCP/IP).

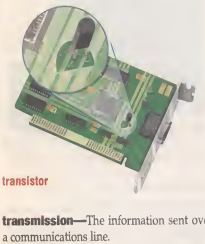
transfer rate—The speed at which information or instructions can be moved between locations. Transfer rate is measured

in units of information per units of time. For example, the transfer rate for a modem is measured in bits per second (bps).

transfer time—The length of time it takes to complete a data transmission.

transient—An area in RAM where a program resides until it is replaced by another opened program. The term also can refer to the program in such storage. Also can mean a random, inexplicable electronics error.

transistor—Term derived from transfer resistor. A semiconductor device that controls the flow of current. A transistor can amplify a signal or turn the signal on and off. The transistor is part of almost any electronic device.



transistor

transmission—The information sent over a communications line.

transmission channel—See channel.

Transmission Control Protocol/Internet Protocol (TCP/IP)—Developed by the U.S. Department of Defense, TCP/IP is a language governing communication among all computers on the Internet. TCP/IP is two separate protocols, TCP and IP, that are used together. The Internet Protocol portion of the standard dictates how packets of information are sent out over networks. IP has a packet-addressing method that lets any computer on the Internet forward a packet to another computer that is a step (or more) closer to the packet's recipient. The Transmission Control Protocol ensures the reliability of data transmissions across Internet-connected networks. TCP checks packets for errors and submits requests for re-transmissions if errors are found; it also will return the multiple packets of a message into the proper, original sequence when the message reaches its destination.

transmission standards—See CCITT V series.

transmit (XMT)—Sending data from one point to another point, usually over a telecommunications link.

transmit data (TXD)—A physical line that transmits information between two sources, such as a computer to a modem. See receive data.

transparent—A device or program that has no effect on the data that passes through it, or a device or program that works so efficiently that the user is unaffected or unaware that it is even working.

transparent operating system (TOPS)—A local-area network (LAN) that can connect IBM, Apple, and Sun microcomputers to each other. Transparent means that users see the interface for the computer they are using. TOPS doesn't require a dedicated file server, as it uses peer-to-peer communications.

transportable computer—See portable computer.

trap—See interrupt.

trap handler—See interrupt handler.

Travan technology—An updated standard for quarter-inch cartridge (QIC) backup tape developed by 3M. Travan tapes are denser and longer than standard QIC tape, which means they can hold about twice the amount of data of a comparable QIC tape. Compare to quarter-inch cartridge.

tree structure—A hierarchical data structure that organizes data elements, called nodes, by connecting them with links, called branches. When a tree structure is diagrammed, the main node represents the root, and nodes within the main node represent branches and leaves.

triad—A group of three phosphors (one each of red, green, and blue) on a computer monitor's screen that compose a pixel. See phosphor. See pixel.

trichomatic—Using a mixture of red, yellow, and blue to render the entire color spectrum. A color inkjet printer's ink cartridge will have vials of each color inside, which it sprays in different quantities onto paper to create other colors.

trillion—A large number that plays to the tune of one million million (1,000,000,000,000).

triplet—A byte that is made up of three bits. Although most modern computer systems define a byte as eight bits, manufacturers can define a byte as a different number of bits.

Trojan horse—A virus that falsely appears to be a useful application, such as a game or a utility, that slips into a system unnoticed. See virus.

troubleshoot—To solve problems or attempt to ascertain what may be wrong with a device or program. Most user manuals have a troubleshooting section that lists common problems and their solutions.

truck chaser—Slang term used to describe a persons who wants a service or device so badly that he or she would literally chase after that particular service or device provider's truck if it were to drive through their neighborhood, in the hopes of having the service or device installed immediately.

tree structure

True BASIC—A version of the programming language Beginner's All-purpose Symbolic Instruction (BASIC) that the original authors, John Kemeny and Thomas Kurtz, wrote in 1983 to update the language in response to criticisms of the original language. True BASIC is a compiled, structured language. It doesn't require line numbers, as the original BASIC did, and it includes the advanced control structures necessary for structured programming. See BASIC.

true color—The use of at least 24 bits to represent each pixel in a graphic. More than 16 million colors can be shown with 24-bit color. This is substantially more than the approximately 250 colors that the unaided human eye can discern.

true complement—See complement.

TrueType—A scalable font that can be printed or displayed on-screen at any size. Introduced in 1991 and developed by Microsoft Corp. and Apple Computer, TrueType fonts can be used by all Windows and Macintosh operating systems.

TSR—See terminate-and-stay-resident program (TSR).

TTY—See teletypewriter.

tuple—A record, or row, of a relational database. See relational database.

Turing machine—A machine proposed by Alan Turing in 1936 that became the foundation for theories about computing and computers. The machine was a device that printed symbols on paper tape in a manner that emulated a person following a series of logical instructions. Turing went on to propose that computers could equal the thought processes of a human brain, if a set number of states of mind could be determined.

Turing test—A test developed by Alan Turing, inventor of the Turing machine. He proposed that if a computer could pass for a human in his test, it could be said to be able to "think." Turing's test involved putting a human interrogator in a room with two terminals, one connected to a human, the other to a computer. If the interrogator couldn't tell the difference between the two during his communication, the computer passed and demonstrated human intelligence. So far, no computer has passed the test.

turnaround time—See response time.

turnkey system—A computer system that is ready-to-go (just "turn the key"). Turnkey systems come equipped with all necessary hardware and software for a specific environment or set of tasks. For example, a law office might have a turnkey system set up with software needed for the staff's tasks. Not all consumer PCs are turnkey systems; many consumers need to add software or hardware to the PC before being able to use it for their specific needs.

turnpike effect—The "rush-hour traffic" on a communications line or network. Too many users can slow or even stop the transfer of information.

turtle graphics—See logo.

tutorial—An instructional lesson. Tutorials can be presented in almost any medium: books, tapes, programs, and CD-ROMs. Many programs, including the Windows and Windows 95 operating systems, include a tutorial so you can practice with the software before using it.

TV tuner card—An expansion board placed in a PC that acts as a TV tuner. The tuner card receives signals from an antenna or cable like any regular TV set. Additional software then

TV tuner card

allows users to change the channels or settings as if operating a television.

TWAIN—See Technology Without An Interesting Name.

tweak—To make minor improvements to a computer system.

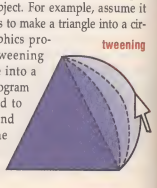
tweening—In a graphics program, tweening is the process by which a computer shows the stages of an object's transformation. Short for in-betweening, the process is capable of just that: it can show every step in-between the beginning and end shapes of a given object. For example, assume it takes 10 steps to make a triangle into a circle. If a graphics program was tweening that triangle into a circle, the program could be told to show any and each of the steps during this change.

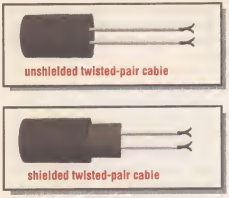
tuple

Employees : Table

Employee ID	Last Name	First Name	Title
1	Davolio	Nancy	Sales Representative
2	Fuller	Andrew	Vice President, Sales
3	Leverling	Janet	Sales Representative
4	Peacock	Margaret	Sales Representative
5	Buchanan	Steven	Sales Manager
6	Suyama	Michael	Sales Representative
7	King	Robert	Sales Representative
8	Callahan	Laura	Inside Sales Coordinator
9	Dodsworth	Anne	Sales Representative
(AutoNumber)			

Record: 10 of 10





twisted-pair cable

twisted-pair cable—A type of cable made by intertwining two separate insulated wires together. There are two types of twisted-pair: shielded and unshielded. Shielded has a fine wire mesh surrounding the wires to protect the transmission; unshielded does not. Shielded cable is used in older telephone networks, networking, and data communications to reduce outside interference.

two's complement—A binary number created by reversing all the digits and then adding 1. In computing, the two's complement often is used to represent negative numbers. See **binary numbers**.

two-dimensional (2-D)—Drawings or sounds in only two of the three dimensions (left-right, up-down, near-far). Two-dimensional drawings lack information about whether an object is near or far. In a drawing of a barn, for example, you would only be able to see one side of the barn at a time. The other sides, which would provide cues as to how far away the barn is and how long it is, are in the unseen third dimension. Likewise, 2-D sounds lack information on whether a sound is coming from above or below. Near-far can be simulated by changing the volume and ambient noise. Left-right is easily reproduced with a pair of stereo speakers, but speakers can't give cues as to up and down. For example, a pair of speakers on the floor can't reproduce hearing a plane fly overhead—it would sound as if there was a plane taxiing on the floor. See **three-dimensional (3-D) audio**. See **three-dimensional (3-D) video**.

TXD—See **transmit data (TXD)**.

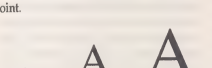
type—To input characters into a computer with a keyboard. Also can be used to describe the characters that make up text.

type 1 font—The most common type of PostScript font. See **PostScript**.

type ball—A sphere that contains raised characters on its surface. Mounted on the printer head of a printer or typewriter, a type ball is used to imprint characters onto a paper's surface. Similar in operation to a thimble printer. See **thimble printer**.

type font—See **font**.

type size—How the dimensions of a character appear on-screen and on paper. Type size is measured in points. A common type size for words in a newspaper article is 10 points, while a headline would be larger. See **point**.



type size

type style—The extent to which a typeface is slanted. If characters have no slant (upright), they are called normal type. If they are slanted forward, they are italicized. See **italic**.

typeahead—When a program stores characters in a buffer before sending them to the screen. Although many programs have this capability, it is not universal. You can see typeahead when, for example, you are typing in a word processor document, and an automatic save operation takes place; the letters you typed as you were saving will appear after the document has been saved. See **character**.

typeahead buffer—A storage area that holds typed characters. See **typeahead**.

typeface—A certain design for a character set. The typeface is just one aspect of a character's font. Examples of typefaces you're likely to find in a word processing program include Arial, Times New Roman, and Garamond. See **font**.

typematic rate—The number of times a computer will repeat a character when its key is held down on the keyboard. Sometimes called the repeat rate. See **character**.

typeover mode—See **overwrite mode**.

typesetter—See **imagesetter**.

U

UART—See **universal asynchronous receiver-transmitter (UART)**.

UART overrun—(Pronounced YOU-art.) A condition that occurs when a universal asynchronous receiver-transmitter (UART) can't process one byte of information before another one arrives. The first byte then disappears, causing a communications error. To avoid this problem, a PC's configuration should be set to a 16-byte buffer instead of the typical one-byte buffers, letting these temporary memory storage areas hold more information. The 16550 is a UART with a 16-byte buffer.

UDMA/33—See Ultra DMA.

UDMA/66—The AT Attachment (ATA) interface expected to come after UDMA/33, to which it bears great similarity. UDMA/66 offers burst data transfer rates twice as fast as UDMA/33. Speed improvements are especially evident when performing long sequential data transfers such as reading digital movies or sound clips. UDMA/66 technology, which is forecast to be available in hard drives and motherboards in 1999, is expected to be the last of the ATA/IDE interfaces. IEEE 1394 (better known as FireWire) operates at a much higher speed and the developers of the UDMA/66 specification admit that UDMA/66 will serve as a transition to IEEE 1394. See IEEE 1394. See UDMA/33.

ULSI—See ultra-large-scale integration (ULSI).

Ultra DMA (UDMA/33)—A new standard developed by Quantum and Intel for transferring data between hard drives and computers. It replaces the old AT Attachment (ATA) standard, also known as Integrated Drive Electronics (IDE). UDMA allows a burst rate (a theoretical maximum) of 33.3 megabytes per second (MBps), twice the speed of old ATA/IDE hard drive interface standard. The standard is available only on newer motherboards or through an add-in card. Ultra DMA also performs a Cyclic Redundancy Check (CRC) to detect data transfer errors between the hard drive and computer. The standard's backers tout UDMA as a cost-effective alternative to the Small Computer System Interface (SCSI) standard. UDMA hard drives are also backward-compatible with older systems—they use the same 40-pin connectors that all IDE drives use and will step down to speeds the older computers can handle. See Integrated Drive Electronics (IDE). See Small Computer System Interface (SCSI).

ultra-large-scale integration (ULSI)—The density of transistors on an integrated circuit (computer chip) and the degree of connections' fineness between circuits. ULSI usually applies to any integrated circuit with more than 10 million transistors. This type of integration allows chip manufacturers to get more transistors on one tiny piece of silicon.

ultralight computer—Another term for a portable computer, which is a type of computer that can be transported easily from place to place. An ultralight PC weighs between 2 pounds and 8 pounds and usually can fit in a briefcase. These computers are

ultralight computer

powered by either a battery or transformer pack. Some of these systems use a RAM drive instead of a hard drive or diskette drive. See laptop computer. See notebook computer. See portable computer.

ultrasonic positioning device (UPD)—A virtual reality technology that tracks position (X, Y, and Z) as well as orientation (roll, pitch, and yaw) through sensors that transmit signals to a primary central processing unit (CPU), which then processes and transmits all on-screen position and orientation values in relation to a user's position in the room. It can be used in a handheld device such as a joystick, mouse, PC remote control, or Internet navigation tool. See virtual reality (VR).

UMA—See upper memory area (UMA).

UMB—See upper memory block (UMB).

unarchive—To restore files from an archive or backup to their original location, usually a hard drive. Compare to archive file.

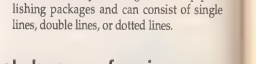
unbundled—Software or hardware that once was included with several other products (a bundle) but was removed from the packaging or is sold separately. For example, games and word processing applications often are bundled with new computers and included in the price. When the product is sold separately, however, it is considered unbundled. Compare to bundled software.

undelete—To restore a deleted file using a utility program such as Norton Utilities or by using the UNDELETE command in DOS 5.x and newer. Deleted files are not actually erased until the storage area where they reside is needed for another file. Therefore, it is sometimes possible to undelete a file. Also called unerase. Compare to delete.

undercolor separation—Using the CMY color model to convert cyan, magenta, and yellow to equivalent grays when printing a color document. This separation produces higher quality grays than grays produced when cyan, magenta, and yellow are mixed. The CMYK color model adds black to cyan, magenta, and yellow to make richer black hues.

underflow—A mathematical calculation that results in a number so close to zero that a computer cannot represent it using binary digits. Some systems will give the user an error message if this occurs; while other computers will guess at the number and go on.

underline—A section of text in a document where the words have a line running beneath them. Underlining is usually done in either word processing or desktop publishing packages and can consist of single lines, double lines, or dotted lines.



underline

underscore—A character in a document that is underlined. The underscore usually denotes emphasis on a letter or a word.

undo—A command that reverses the action mostly recently completed. Some programs, however, let several commands be undone at once. Whenever a user chooses the undo button in a word processing program, the previous command is undone. For example, if a section of the document is changed or deleted and then the user wants the original back, the undo feature will retrieve the deleted information.

undocumented—Any information that isn't found in printed documentation accompanying a product. This is usually data that programmers didn't think users needed, or it might cover untested features in a product. Compare to README file.

unerase—See undelete.

Unicode—Represents characters as integers in lines of computer code. This standard is different from ASCII in that it uses two bytes (16 bits) for each character instead of one byte (eight bits). This allows Unicode to represent more than 65,000 characters as opposed to the 256 that the American Standard Code for Information Interchange (ASCII) can handle, making it capable of producing the appropriate characters for most languages. This feature isn't important in English because all English characters can be represented by ASCII. For the non-Roman languages, however, such as Japanese and Chinese, Unicode lets all characters in those languages be represented by rearranging the 16 bits into different formats. Compare to **American Standard Code for Information Interchange (ASCII)**.

unified interface—An interface for a Web page that performs a Web search using several different search engines at once. Instead of typing the word into several different fields, users can type the word in once and the unified interface executes several searches simultaneously. A good example is AskJeeves (http://www.ask.com). Also known as a united search interface. See **search engine**.

uninstall—To remove software from a computer. Applications can be uninstalled using their own uninstall utilities, if available, or through the Add/ Remove Programs function in Windows 95/98/NT. Separate standalone uninstall programs perform diagnostics on a hard drive to uncover which files are present, what their characteristics are, and which may be safely discarded. One of the difficulties of uninstalling Windows programs is the shared dynamic link library (DLL) file. When software is installed, DLLs are placed in a common directory, and are often used by more than one program. Removing a shared DLL can thus cause other programs not to function.

uninterruptible power supply (UPS)—A generator connecting a PC to the power supply that provides backup power for a computer system in case of a power outage (blackout), brownout, or power surge. A UPS contains a battery and provides power for a short time, usually long enough for the original power source to be restored or for users to save their work to their hard drive and shut the system down safely. Many UPSes now are bundled with software packages that can automatically save work and power down the system if the user is away from the PC when the outage occurs. Two types of UPSes are available. One, a standby power system (SPS) or offline system, monitors power line activity and will switch the system to battery power if something goes wrong. This switch can take several milliseconds, stopping power from traveling to a PC during this time. The other, more expensive option, an online UPS system, will give a PC constant power from an inverter or battery, even if a problem is found in the lines.

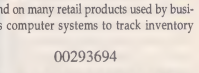
unipolar—A device that uses the same voltage polarity (either positive or negative) to represent binary states, such as on or off.

UNIVAC I (Universal Automatic Computer)—One of the first electronic computers made commercially available that could process numbers and text. The design was bought from J. Presper Eckert and John Mauchly in the early 1950s by Remington Rand, which became the world's first large-scale computer company. The company sold 46 of these computers to government and industry. In 1952, this machine produced results that predicted Dwight D. Eisenhower's victory over Adlai Stevenson for the U.S. presidency. This event made UNIVAC synonymous with the term "computer."

UNIVAC (Universal Automatic Computer)

universal asynchronous receiver-transmitter (UART)—(Pronounced YOU-art.) The most common type of circuit used to connect modems and manage serial ports, converting bytes into serial bits that can be transmitted. The UART also converts incoming serial data into parallel data so it can be received. The difference between UART and universal synchronous receiver-transmitter (USRT) is that a UART module has the receiving and transmitting circuits needed for asynchronous serial communication, which is when two modems rely upon the other to send start and stop signals to set the pace for information exchange. Without this, the modems can't detect when packets of information begin and end because this process doesn't rely upon clock signals. Compare to **universal synchronous receiver-transmitter (USRT)**.

Universal Product Code—A bar code found on many retail products used by business computer systems to track inventory



Universal Product Code

and provide point-of-sale automatic pricing. Computers can read the bar code with a scanning device and translate the data into a number.

universal resource locator (URL)—A standardized naming, or "addressing," system for documents and media accessible over the Internet. The URL http://www.smartcomputing.com, for example, includes the type of document (http, Hypertext Transport Protocol), and the address of the computer on which it can be found(www.smartcomputing .com). File-Transfer Protocol (FTP) sites, newsgroups, Gopher pages, and other sites all can be named with URLs.

universal resource locator

http://www.smartcomputing.com

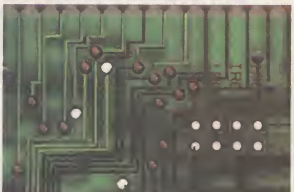
universal serial bus (USB)—A new type of external bus expected to replace parallel and serial ports. With a maximum transfer speed of 12 megabits per second (Mbps), USB is designed primarily for low- to mid-speed peripheral devices, such as keyboards, mice, modems, printers, joysticks, and some scanners. More bandwidth-intensive devices, such as digital video cameras and storage devices, will eventually use the IEEE 1394 (FireWire) standard. A main advantage of USB over traditional ports is that it offers easy expandability; up to 127 devices can be daisy chained, far more than the number of devices supported by traditional ports. All USB devices support plug and play and hot swapping as well. The computer automatically recognizes any USB device as soon as it's plugged in or added to the chain. Desktop computers that support USB typically have two four-pin USB ports—one for a keyboard and mouse daisy chain, the other to daisy chain all other USB devices. USB was introduced in computers shipped in 1997 and has received a boost from Windows 98, which offers better support for the standard that Windows 95. Future versions of Macintosh computers are expected to support the standard. The iMac, for example, has no serial or Small Computer System Interface (SCSI) ports, only USB ports. See **bandwidth**. See **daisy chain**. See **IEEE 1394**.

universal synchronous receiver-transmitter (USRT)—A circuit in which both the receiving and transmitting circuits are built into a single integrated circuit, allowing for synchronous serial communication. This type of communication doesn't require start and stop coding to be placed in every packet of data sent because the receiving unit automatically understands when data packets start and stop. Compare to **universal asynchronous receiver-transmitter (UART)**.

Unix—A powerful operating system developed by AT&T Bell Laboratories in 1969 and used primarily by universities and mid-sized businesses. Written in the C programming language (which is popular for PC use because it takes less memory to use than other languages), this multiuser, multitasking operating system was designed for both large mainframes and minicomputers. It can be used on many platforms and can run a wider variety of hardware than other operating systems. This operating system is more popular for workstation computers on networks rather than individual PCs.

unload—The process of removing a program from memory. This procedure is most useful when dealing with terminate-and-stay resident programs (TSRs), which load into memory and reside there, using space even if they're not being used.

unmount—The action of stopping a computer from accessing diskettes or tape by removing the diskette or tape from use. Compare to **mount**.



unpack—To restore compressed information to its original form. This term also refers to the way database programs mark entries for deletion. Compare to **pack**.

unpopulated board—A circuit board, found inside a PC, containing empty sockets. Compare to **populate**.

unprintable character—A hidden command in a document that will not be printed when the document is sent to the printer, because it usually represents formatting commands that tell the program to perform functions such as return and indent. Examples of these characters include the TAB, ENTER, ALT, and CTRL keys.

unrecoverable error—An error that occurs during a PC's operation that no number of retries can correct.

unshielded twisted pair cable—See **twisted pair cable**.

unzip—To decompress a file. Compare to **zip**.

UNZIP—To decompress a file with PKWARE Inc.'s PKUNZIP software package. Files are often zipped (compressed) before they are sent to another PC via an online service or through the Internet so they don't take as long to transmit and download. When zipped files reach their destination, they must be unzipped (uncompressed) before they can be used. See **file compression**. Compare to **ZIP**.

up—Signifying that the system, program, or printer in question is working and ready to be used.

UPC—See **Universal Product Code (UPC)**.

update—To replace older versions of software or files with a newer version. Also refers to when a company releases a new version of software that's already on the market. This is usually indicated by a change in the version number, such as changing from 6.2 to 6.21. These software updates usually fix minor problems, or bugs, the older version contained. See **upgrade**.

upgrade—To change a system or program to a new version of a specific hardware or software product. Usually, companies will provide registered users with the more powerful upgrade of a product at a discounted price to keep them as customers. Also can refer to the new version of a product (such as the upgrade for Microsoft Word). See **update**.

upload—To transfer an application or file to another remote computer through a network connection or modem. Upload also can mean "transmit," while download can mean "receive." Compare to **download**.

upper memory area (UMA)—The area of RAM between 640KB and 1,024KB (1MB) that has been made into usable RAM. In DOS-based systems, memory is split into five areas: conventional memory, upper memory, high memory, extended memory, and expanded memory. The UMA consists of upper memory blocks, and users can access this area through a special memory manager, such as Emm386.exe. See **upper memory block**.

upper memory block (UMB)—Areas of computer memory from 640KB to 1024KB that are mapped for use with the aid of memory management software. Terminate-and-stay-resident programs (TSRs) and device drivers can be loaded into these blocks to free conventional memory for use by other programs. See **upper memory area**.

uppercase—A capital letter, such as A, B, or C. The first letters of sentences are uppercase. Software programs that distinguish

ABCDEFGHIJKLM
NOPQRSTUVWXYZ
uppercase

between uppercase and lowercase letters are "case sensitive." Compare to **lowercase**.

UPS—See **uninterruptible power supply (UPS)**.

uptime—The length of time a user can work on a computer before being interrupted. Compare to **downtime**.

upward compatible—The ability of devices and programs, usually software, to recognize and use technologically advanced systems that will become standard in the future. For example, many programs designed for the 80486 CPU also can be used on a Pentium system. These products are attractive to users because when they upgrade to a newer computer system, they won't have to transfer all their files to new programs. Also called forward compatible. Compare to **backward compatible**.

URL—See **universal resource locator (URL)**.

usability—Describes the ease or difficulty of using a product for a specific task. If a product has high usability, for example, it means that it's flexible, is easy to learn how to operate because of its good design, and is essentially free of problems or bugs.

USB—See **universal serial bus (USB)**.

Usenet—A giant bulletin board on the Internet consisting of user news, E-mail, and forums that discuss thousands of topics. Usenet newsgroups can be accessed through the Internet or other online services with a modem. Users can communicate on this Unix network by posting a message about a topic, then waiting for a response. Started in 1979, this network was used as a bulletin board between two universities in North Carolina and has grown into a large public access area. See **newsgroup**.

user—Any nonprofessional person (those who don't program computers or provide technical support for them) who works with PCs. See **end user**.

user account—An individual set of parameters and profiles designed for one user of a multiuser system, such as for each family member using a home PC. It often consists of information about the user, such as the user's name and the password required to access the system, in addition to information about which files and programs the individual can use.

user friendly—A program or system that can be learned and used with relative ease. An example of a user-friendly operating system is Microsoft's Windows 95.

user group—Consists of a group of people with similar computer interests, either about hardware or software, who exchange ideas and PC tips to improve their understanding of the product. These gatherings either can cover a broad range of topics with subgroups (called special interest groups or SIGs) for more specialized interests or can concentrate on specifics, such as a certain movie or television show. See **special interest group (SIG)**.

user interface—The part of the software the user works with, whether it be through commands or menus. Interfaces can be either text-driven, such as DOS, or graphical user interfaces (GUIs), such as Windows. See **command-line interface**. See **graphical user interface (GUI)**.

user name—A code used by individuals, in addition to a password, that lets them access a network computer, an online service, or a bulletin board system. Most of the time, users select their own user names and passwords.

user profile—A set of personalized parameters that contain information about a person's electronic mailbox location and access rights. Normally used for security purposes, each authorized user on a network or multiuser PC must have one of these, often used in conjunction with a user name and password. See **user account**.

USRT—See **universal synchronous receiver-transmitter (USRT)**.

utility—Software designed to perform certain housekeeping tasks, such as those related to managing system resources (such as diskette drives and printers) and file capabilities (such as sorting and copying). Utilities also can be used to diagnose a problem on a PC. Utilities are usually installed as memory-resident programs permanently stored in memory.

utility program—See **utility**.

V

V.21—A CCITT V series standard for full-duplex transmission at a speed of 300bps. This standard is used with dial-up lines

(regular telephone lines, making the connection by placing a telephone call). V.21 is used in Japan and Europe; in the United States, the Bell 103 standard is used instead. See **Bell-compatible modem**. See **CCITT V series**.

V.22—A CCITT V series standard for full-duplex transmission at a speed of 1200bps, over dial-up lines or leased lines (telephone lines leased for private use). Leased lines provide slightly wider bandwidth than dial-up lines, are faster and quieter, but also are more expensive. Although V.22 is common in Europe and Japan, the Bell 212A standard is more common in the United States. See **Bell-compatible modem**. See **CCITT V series**.

V.22bis—A CCITT V series standard for full-duplex transmission at speeds of 1200bps or 2400bps with dial-up or leased lines. This standard is worldwide. See **CCITT V series**.

V.23—A CCITT V series standard for half-duplex transmission at speeds up to 1200bps on dial-up or leased lines. This standard is worldwide. See **CCITT V series**.

V.26—A CCITT V series standard for full-duplex transmission at 2400bps over dial-up lines. This standard is worldwide. See **CCITT V series**.

V.26bis—A CCITT V series standard for full-duplex transmission at speeds of 1200bps or 2400bps over dial-up lines. This standard is worldwide. See **CCITT V series**.

V.27—A CCITT V series standard for full-duplex transmission at 4800bps over leased lines. Modems conforming to this standard have manual equalizers, which allow them to compensate for distortion and delay so the signal reaches the receiving device in its original form. This standard is worldwide. See **CCITT V series**.

V.27bis—A CCITT V series standard for full-duplex transmission at speeds of 2400bps to 4800bps over leased lines with automatic equalization. This standard is worldwide. See **CCITT V series**.

V.27ter—A CCITT V series standard for full-duplex transmission at speeds of 2400bps to 4800bps over dial-up lines. This standard is worldwide. See **CCITT V series**.

V.29—A CCITT V series standard used by fax modems for half- or full-duplex transmission at speeds up to 9600bps over point-to-point leased circuits. This standard is worldwide. See **CCITT V series**.

V.32—A CCITT V series standard for full-duplex modems transmitting data at 4800bps or 9600bps. These modems adjust transmission speed automatically depending upon line quality and have echo cancellation to remove the phone-line echo. See **CCITT V series**.

V.32bis—A CCITT V series standard for modems transmitting at speeds up to 14,400bps over leased or dial-up lines. An extension of the V.32 standard, this standard is worldwide. See **CCITT V series**.

V.34—A CCITT V series standard for full-duplex transmission at speeds up to 28,800bps. Modems adhering to this standard automatically adjust their speed to compensate for the quality of the phone line. This standard is worldwide. See **CCITT V series**.

V.42—A CCITT V series standard for regulating error-detection for high-speed modems. Modems conforming to it can be used over digital telephone networks, as opposed to the standard analog telephone networks. This standard is worldwide. See **CCITT V series**.

V.42bis—A CCITT V series standard for data compression that lets modems reach data transfer speeds of up to 34,000bps. This standard is worldwide. See **CCITT V series**.

V.90—The modem standard reached by the International Telecommunications Union (ITU) on Feb. 5, 1998 for 56 kilobits per second (Kbps) modems. (The standard won't become official until sometime in the fall of 1998.) This new standard is a mix of the K56flex standard, supported by Rockwell International Corp. and Lucent Technologies Inc., and x2 technologies, supported by 3Com Corp. All the manufacturers will adopt the new standard. V.90 modems are for connections which are digital at one end and have only one digital-to-analog conversion. See **digital-to-analog converter (DAC)**. See **modem**.

V86 mode—See **virtual real mode**.

vaccine—Utility programs that can protect computers from viruses. See **utility**.

vacuum tube—A glass tube from which all gas has been removed, creating a vacuum. Such tubes containing electrodes for controlling electron flow were used in early computers (before semiconductors) as a switch or an amplifier. Vacuum tubes allowed digital computations at what was then considered a high speed.

validity checking—To check data, either through software or manually, to see if it adheres to certain standards. A diskette could be checked for corrupted information, or information could be checked to make sure it adheres to the standards for a program, such as numbers falling within a designated range.

value-added network (VAN)—(Pronounced van.) In addition to being a simple communications network, a VAN offers users additional services ranging from message routing to stock quote services.

value-added reseller (VAR)—(Pronounced var; rhymes with car.) A company that sells computer systems with all the trappings. Typically, a VAR buys hardware components and software based upon the client's needs and installs the custom-made system for a client. VARs also provide after-sale training and support.

VAN—See **value-added network**.

vaporware—A satirical name used to describe software that has been announced by a company but apparently does not yet exist. It is often applied to new products companies claim to be working on but no one outside the company has actually seen. Also refers to products that have passed their announced ship date without appearing. Critics often accuse companies of intentionally creating expectations for vaporware to keep customers from buying competing products that are already available.

VAR—See **value-added reseller**.

variable—A common programming concept in which a storage location contains data that can be altered by the program whenever necessary. Just as in an algebraic equation, the value of a variable such as X can fluctuate according to circumstances. Variables allow flexibility in program writing because information adjusts depending upon the situation rather than being entered as an absolute. Thus, a single program can handle many sets of data.

variable expression—A program expression that contains one or more variables, the values for which are not constant. In the process of running the program, it must ascertain their value. Compare to **constant expression**.

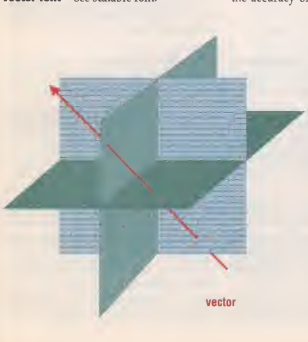
variable-length field—An object with adjustable length. In a database, for example, a variable length TITLE field means the field will be just long enough to accommodate each title. Compare to **fixed-length field**.

VDSL—See **Very High Bit-Rate Digital Subscriber Line (VDSL)**.

VDT—See **monitor**.

vector—A line calculated in either two dimensions or three dimensions and defined by its endpoints, which are coordinates in a grid.

vector font—See **scalable font**.



vector graphics—See **object-oriented graphics**.

vendor ID—A number that allows plug-and-play systems to identify an added device and configure it properly. The number indicates the device's manufacturer, model, and version number.

version—A number used to indicate a program's stage of development. A new software version, indicated by product name changes such as WorkSmart 3.1 to WorkSmart 4.0 (pronounced four point oh), indicates that the software has been updated or improved. Major upgrades are indicated when the number before the decimal point changes, as in the previous example. Minor revisions are indicated by changes in the number after the decimal point (for example, 3.1 to 3.2) and small fixes, such as corrections of program flaws, are indicated by additional numbers or letters (as in 3.2 to 3.2.1 or 3.2a). See **upgrade**.

vertical blanking interval—See **vertical retrace**.

vertical justification—Adjusting the size of the space between lines to make the top and bottom margins equal. This feature is found mostly in word processing and desktop publishing software.

vertical redundancy check (VRC)—An error-checking method used to determine the accuracy of a transmission. For every character transmitted, the VRC generates an additional parity bit. This bit determines whether the character contains an odd or even number of 1 bits. By knowing whether the final parity of the transmission should be odd or even, the VRC can determine if the message is accurate. See **parity**.

vertical portal—A portal Web site with tightly-focused content designed for a particular audience. Garden.com, for example, is a portal site, but only for gardening information. See **horizontal portal**.

vertical retrace—In reference to raster-scan displays, the travel of the electron beam after it has completed one sweep of the screen. Vertical retrace is the action of the beam as it travels from the lower-right corner of a monitor to the upper-left. The beam is turned off during the move from the bottom to the top of the screen, and this "down time" is called the vertical blanking interval. See **raster**.

vertical scrolling—The ability to move a document or spreadsheet beyond the limits of a screen to the top or bottom. Scrolling is usually performed by clicking an arrow on either side of a window, usually inside a scroll bar. See **scroll bar**.

vertical sync signal—A signal in a display that indicates the electron beam has reached the end of the last line at the bottom of the screen. The signal tells the beam to move to the upper-left corner of the screen.

Very High Bit-Rate Digital Subscriber Line (VDSL)—Provides the highest speed for data transfers over existing telephone lines. It supports a downstream rate of 13 megabits per second (Mbps) to 52Mbps and an upstream rate of 1.5Mbps to 2.3Mbps. It provides homes and small businesses with the connectivity necessary for delivering high-bandwidth information over regular telephone lines. See **Digital Subscriber Line (DSL)**.

very low frequency (VLF)—Describes the electrical radiation emitted by computer monitors, televisions, and other cathode ray tubes (CRTs).

very-large-scale integration (VLSI)—An integrated circuit design that contains 5,000 to 50,000 components on a single chip. See **super-large-scale integration**.

VESA—See **Video Electronics Standards Association (VESA)**.

VESA Local bus (VL-bus)—A VESA-created local bus that was up to 20 times faster than Industry Standard Architecture (ISA) buses. The VL-bus was popular until the competing Peripheral Component

Interconnect (PCI) local bus architecture gained widespread acceptance. VL-bus allows for "bus mastering" in which smart adapter cards do some processing without the CPU; this mastering can tie up the local bus and keep the CPU from using it. The VL-bus standard lets up to three VL-bus slots, which each consist of an ISA, EISA, or Micro Channel Architecture (MCA) connector plus a 16-bit MCA connector, be built into the motherboard by the manufacturer.

vesicular film—An optical disc coating that lets information be stored in raised bumps rather than the grooves traditionally used in CD-ROMs. Because the bumps can be flattened, discs using vesicular film can be erased and rewritten. Grooves, on the other hand, cannot be overwritten.

VGA—See video graphics array (VGA).

video accelerator—A video adapter that contains a graphics coprocessor designed to handle graphical computations better than the computer's Central Processing Unit (CPU). The coprocessor increases the speed of on-screen images and improves system performance by relieving the CPU of the graphical tasks, letting it handle other tasks. The amount of memory (either DRAM or VRAM) contained on the video accelerator, which has become standard equipment on most new PCS, determines how many colors and which resolutions are possible on the system. Also called a graphics accelerator.

video adapter—A circuit board in a computer that controls display factors such as resolution, colors displayed, and speed of images displayed. A video adapter cannot bring an older monitor up to its standard. Both the monitor and the video adapter must support a resolution, such as 800 by 600, for that resolution to be possible on the system. Today's video adapters typically contain some memory so that the PC's RAM isn't bogged down with handling displays. Some adapters, often called video accelerators or graphics accelerators, contain a graphics coprocessor that handles graphical computations. Also called a video card, video board, or video controller.

video board—See video adapter.

video buffer—A section of memory that holds information before it is sent to the monitor. The video buffer, also called a screen buffer or a regeneration buffer, is usually a part of the video adapter.

video cache—A small, high-memory storage area designed to speed up access to stored video files. Being much smaller than a hard drive, the video cache takes considerably less time to load and retrieve files.

video capture—To connect a video camera or other device to a special video capture card that translates the analog video signal into digital data that can be compressed, stored, and manipulated on the PC. See **video digitizer**.

video card—See **video adapter**.

video controller—See **video adapter**.

video digitizer—A device that captures video images such as those from videotape or television and stores them as digital information with the aid of a special circuit board. See **video capture**.

video display page—Before a screen image is displayed on a monitor, it is held in this area of the video buffer. Buffers that can hold more than one page allow quicker display updates because one page can be displayed while another is being filled.

video display terminal—See **monitor**.

Video Electronics Standards Association (VESA)—(Pronounced vee-suh.) A group of monitor and video card manufacturers that set standards for high-resolution monitors and video cards. Buying products that follow VESA standards makes it easier to ensure the components of a system work together.

Video For Windows—A common Windows standard for storing video and audio information in multimedia presentations. Many multimedia companies use Microsoft's Video For Windows standard, which stores files in the .AVI format, because it requires no special hardware and is widely accepted. This standard, and the competing QuickTime (a software-only video format), are being succeeded by more powerful hardware-based technologies such as the Motion Picture Experts Group (MPEG) standard. Video For Windows, with its 320 by 240 resolution and 15-frames-per-second rate, is inadequate for full-screen, full-motion video.

video graphics array (VGA)—A popular display standard developed by IBM that provides 640 by 480 resolution color-display screens with a refresh rate of 60 hertz (Hz) and 16 colors displayed at a time. If the resolution is lowered to 320 by 200, 256 colors can be displayed. VGA capability is built into plug-in video cards, VGA chips, and monitors that can work with the VGA video cards. VGA, unlike the older CGA and EGA standards, uses analog rather than digital information, allowing it to display an infinite color range. This means the older standards are incompatible with VGA. Most new computers use the Super-VGA (SVGA) standard, which can support 800 by 600 and higher resolution. See **video standards**.

video memory—Located on the video card, video memory is accessible by both the video processor and the CPU and is used to create images on a computer screen.

video mode—The state of a video adapter. In general, this is either text mode, where the monitor will display numbers, letters, and so forth, or graphics mode, where the monitor will show images.

video RAM (VRAM)—(Pronounced vee-ramm.) A special, more expensive type of RAM chip that can perform reads and writes at the same time, making it faster than dynamic RAM (DRAM). This means the chip can send information to the monitor at the same time it receives new information from a video processor. VRAM chips, which enhance graphics performance, often are placed on video adapters to speed the creation of on-screen images. Also called dual-ported memory. Compare to **dynamic RAM (DRAM)**.

video signal—The signal a video adapter sends to a display device to control an on-screen image.

video standards—The various definitions of a PC's ability to display colors and resolution. A PC supports a certain video standard only if both the monitor and the video adapter support the standard. The numbers specified for a standard often are minimums; many manufacturers claiming to meet that standard actually exceed the minimum numbers. Consult the chart on this page for the video standards most commonly seen today (horizontal pixels are listed first).

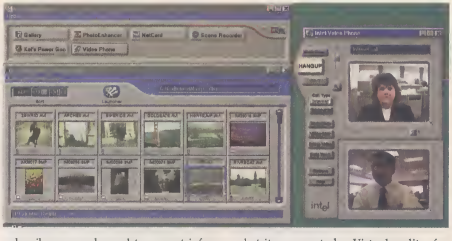
videoconferencing—A conference among participants situated at different sites that are connected by video cameras, microphones, and a computer network. Participants each sit in front of the camera and microphone, and view and listen to the other participants as information is transmitted through the network to a computer screen and speakers.

videodisc—The predecessor to the CD-ROM, videodiscs originally were designed to store movies. They are the size of an audio LP.

videoteleconferencing—Another term used for videoconferencing, which allows several people to hold a communications session from various geographical locations via video.

Videotex—A home information service (most popular in Europe) in which

videoconferencing



subscribers use a keypad to request information sent over telephone lines and displayed on a Videotex screen or an ordinary television. The information, which is text and simple graphics, usually includes topics such as news, weather, and shopping.

viewer—A utility for viewing a file in its native format, which is the format of the program in which it was created. Shell programs and file managers commonly offer viewers for many file types. A single file viewer usually supports many document, database, and spreadsheet file formats.

virtual—Used generally to describe something without a physical presence or is not what it appears to be. Virtual reality, for example, is made up of computer-generated images and sounds rather than actual objects. Virtual memory is a hard drive acting as memory; it's not the physical chips used in real memory.

virtual 8086 mode—See **virtual real mode**.

virtual address—The address a program uses to reference data stored in a virtual memory system. Before the data is accessed, the memory management unit (MMU) translates the virtual address into a physical address so it can be read by the intervening hardware and/or software. See **virtual memory**.

virtual circuit—A communications link that appears to connect a transmitter and a receiver directly, though it may actually route through several stations on the path between the two.

virtual device—A device, such as hard drive space mimicking memory, that can be referenced even though it doesn't actually exist. Virtual memory, for example, does not physically exist on memory chips; it's hard drive space mimicking memory.

virtual device driver (VxD)—Virtual device drivers act as a simulation buffer between applications and hardware. The drivers sort out and ensure that the correct application gets the information. With this setup, multiple applications can access the same hardware without causing conflict. In a device file name, V means virtual and D means device. The middle character(s) further define the device driver; for example,

video standards

Video Standards

	Resolution	Simultaneous Colors
VGA	640 x 480 320 x 200	16 256
SVGA	800 x 600 1,024 x 768 1,280 x 1,024 1,600 x 1,200	16 to 16 million 16 to 16 million 16 to 16 million 16 to 16 million
8514/A	1,024 x 768	256
XGA (Extended Graphics Array)	640 x 840 1,024 x 768	65,536 256
TL34010	1,024 x 768	256

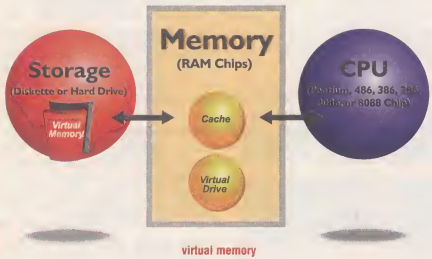
VmD represents a mouse driver. In Windows' System.ini file, there is a section called [386Enh], in which references to these drivers can be found. If the driver referenced is in another file, it will have a .386 file name extension (such as "Device=vmd.386"); if it is part of the Windows Enhanced mode kernal, the .386 extension is replaced with an asterisk (as in "Device=*vmd").

virtual disk—See RAM disk.

virtual image—An image contained in memory that is too large to fit on the screen. Therefore, users scroll around the screen to bring portions of the image into view.

virtual machine—Software imitating a physical device, such as the Softwindows programs that allow users to run Windows programs on Macintosh computers.

virtual memory—A type of hard drive space that mimics actual memory (RAM). When actual memory space is limited, the use of virtual memory can let users work with larger documents and run more software at once. When a program needs information held in virtual memory addresses, the information is moved to actual memory addresses. This process of moving sets of virtual addresses (or pages) into actual memory is known as paging or swapping. When virtual memory is used, it appears to the user as if actual memory is in use. The process may be a bit slower, however, because of the time required to swap information between virtual and actual memory.



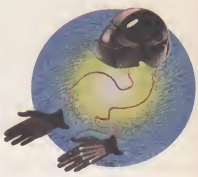
virtual memory

virtual peripheral—A make-believe device. Essentially, tricking the CPU into believing that a device exists when actually it doesn't. For example, fax software can act as a virtual peripheral, setting itself up to work as a virtual printer. When Print is selected, the document is sent to the fax/modem, which then sends the information to another fax/modem or fax machine instead of a printer printing the file.

virtual real mode—A feature that lets Intel Corp.'s 386 and 486 chips operate as if they are several 8086 environments, each of which may run a different operating system. An operating system or operating environment allows virtual real mode by overseeing the operation of each 8086 environment. Software running in each 8086 environment is independent of other environments and acts as if it controls the entire system. Also called virtual 8086 mode or V86 mode.

virtual reality (VR)—An artificial, computer-generated environment in which users interact with the environment and objects in it through specialized input devices such as goggles, headphones, and gloves. Three-dimensional images, moving sound, and tactile feedback provided by the special gloves create realistic situations when generated by high-end computer systems. Goggles and wires also detect the user's movement so images and sounds change relative to head

virtual reality (VR)



position, for example. Virtual reality is used in professional situations such as flight simulators, medical training, and architectural walk-throughs. It's also used in many entertainment applications.

Virtual Reality Modeling Language (VRML)—(Pronounced vermal.) A programming language that supports graphical animation of virtual spaces on World Wide Web pages. Detailed three-dimensional images can be created with small programs, allowing the programs to arrive quickly at users' computers and be viewed easily with special VRML browser applications. Links in VRML "worlds" can connect the worlds to other VRML areas on the Web.

virtual reality Web browsers—Allow for interactive, three-dimensional (3-D) experiences on the World Wide Web. See three-dimensional (3-D).

virus—A program designed to destroy data or halt operation on systems by copying itself into files and executing when those files are loaded. Viruses, which are carried among computers in files contained on diskettes or in online transmissions, usually cause problems on a system. When "infected" files are shared among computers on a company network, for example, the virus can cause extreme damage to a company's data. With antivirus software, users can avoid "infection" by a virus by "disinfecting" every diskette and file that is introduced to the computer. Several popular packages check files for viruses and eliminate any found.

virus pattern databases—Searchable storage areas that log computer viruses'

traits and codes, and in some cases, ways to combat certain viruses.

visible page—A graphic image visible on the screen. Pages, or one screenful of information, are the form in which information is temporarily stored in display memory.

VL-bus—See VESA local bus.

VLF—See very low frequency (VLF).

VLSI—See very-large-scale integration (VLSI).

voice coil—A hard drive head actuator that moves the read/write heads. The voice coil uses electromagnetic feedback from the disk's surface to determine the amount of movement, and to move the read/write head the proper distance. Similar to the coils used to vibrate speaker cones, voice coils move the read/write heads more quickly than the older stepper motors. Compare to stepper motor. See head actuator.

voice mail—An automated telephone answering system in which callers choose options that help them reach the voice mailbox of a particular person, then determine how a message is recorded and delivered. Voice mail systems are handled by computers rather than traditional answering machines.

voice over data technology—A new technology that allows computer users to make voice calls over data networks or Internet Protocol (IP) circuits, thus eliminating the need for telephone lines.

voice recognition—A computer's ability to recognize spoken commands and act on them as if they were keyboard or mouse commands. Voice recognition systems do not understand speech; that is done by natural language systems. Even the best voice (or speech) recognition programs, which can recognize thousands of words, are speaker-dependent. This means users must spend a lot of time repeating words so that the PC is "trained" to recognize their voices' particular tone, rhythm, speed, and pronunciation. Most voice recognition programs are discrete speech systems, in which users must speak slowly and distinctly. Continuous speech programs, which allow natural speech, will become more common in the future. Voice recognition typically is used in situations where users' hands are either too busy or otherwise unable to operate a keyboard or mouse.

voice-grade channel—A communications channel that can carry speech and is commonly used for transferring digital information at speeds up to 9600bps.

voices—The term given to all the notes, or tones, in a sound card. All standard sound cards have at least eight musical instrument digital interface (MIDI) voices that can be played simultaneously; high-quality sound cards may have up to 64 MIDI voices.

volatile memory—Memory whose contents are erased when the system's power is turned off (or interrupted). RAM is volatile, but ROM is not. It is because of RAM's volatile nature that users must frequently save their work to a permanent medium such as a hard drive to avoid losing data if the system's power is interrupted.

volume—The amount of storage on a storage medium, or the name of the medium itself. A single diskette, for example, may contain several volumes, as in situations where a hard drive is partitioned into several drives, each of which is a volume.

volume label—A unique name assigned to a storage medium, usually at the time it is formatted. DOS-based systems rarely use volume labels, but Macintosh systems frequently refer to them on-screen as volume names.

volume name—See volume label.

volume reference number—See volume serial number.

volume serial number—A number assigned by operating systems such as MS-DOS to every diskette that is formatted. Different from a volume label, it is used in situations such as directory listings. Macintosh systems use a similar number called the volume reference number.

von Neumann architecture—A computer design approach that is key to the idea of stored programs, which are stored in the PC and manipulated with instructions. This architecture uses the idea of sequential processing, in which one operation is carried out at a time. With the development of parallel architectures, which handle multiple operations at once, the von Neumann architecture began to get too crowded with data. This architecture was designed by Hungarian mathematician John von Neumann, who promoted it in the 1940s.

VR—See virtual reality (VR).

VRAM—See video RAM (VRAM).

VRML—See Virtual Reality Modeling Language (VRML).

VxD—See virtual device driver (VxD).

W

wafer—A flat disk of silicon crystal sliced from a larger piece. Used in semiconductor chip manufacturing, these disks are approximately 1/30th-inch to 1/50th-inch thick and 3 to 6 inches in diameter. Made to hold circuitry components, wafers are eventually enclosed in another substance, such as plastic or metal.

wafer

WAIS—See Wide Area Information Server (WAIS).

wait state—A pause in a microprocessor's clock cycles that allows for differences in speed between one component and others in a computer (such as input/output devices or RAM). Wait states are common in systems where the microprocessor has a much higher clock speed than other components, requiring the latter to "play catch up." During a wait state, the microprocessor idles for one or more cycles while data comes in from RAM or other components. Although unnoticeable to users, this idling can affect a system's performance because it involves the

microprocessor's clock speed; if clock speed is reduced, system performance will slow. Wait states also are not uncommon between buses and expansion cards, where the expansion cards run slower than their buses.

wallpaper—A bit-mapped graphic that appears as a backdrop on the Windows desktop and other operating environments. In Windows 3.x, wallpaper is controlled from the Windows' Desktop icon in the Control Panel. Wallpaper images can be basic images

wallpaper

(such as the Windows logo) or patterns (such as argyle or tartan) to more elaborate photographs, cartoons, or other images created by users or provided by third-party manufacturers. Also called backdrop.

WAN—See **wide-area network (WAN)**.

wand—A pen-like scanning device, a wand is commonly used with such hardware peripherals as bar code readers. Also used to describe a stylus used with graphics tablets. To scan text with a wand, a user passes the tip of the wand over text; the optical scanning mechanism in the wand takes the text it has "read" and passes it along to the computer for processing.

warm boot—A method of resetting a computer system that is already powered on, commonly used to recover from errors such as General Protection Faults (GPFs). This may be executed by pressing the CTRL-ALT-DELETE keys simultaneously or by selecting a Restart command from an operating system menu. Warm boots run faster than turning a computer off and on again. Warm boots will, however, remove anything that was residing in RAM. Compare to **cold boot**.

warm link—The ability to update data, such as a number in a spreadsheet cell, when it is being displayed in a different application, such as a chart or a graph. This lets the user change the data in the originating application and see the results in other applications that use the same data.

watt—A unit of electrical power equaling the product of amperage and voltage and representing the amount of power a device needs in order to run. Common measurements are kilowatts (1,000 watts), megawatts (1 million watts), milliwatts (.001 watt), and microwatts (.000001 watt).

WAV files—The standard format for storing sound files in PCs. WAV is the file extension for sound files, most often played by some musical instrument digital interface (MIDI) sequencers to synthesize and play audio messages and files. See **musical instrument digital interface (MIDI)**.

wave—The pattern of a signal, such as that generated by sound and light, that changes at regular intervals.

wave audio—A sound wave represented in a digital form that is based upon periodic samplings of waveforms. Also called waveform audio.

waveform—A representation of the pattern of analog signal (amplitude) changes over time during a wave's signal.

waveform audio—See **wave audio**.

waveform editor—A program that lets users record and manipulate wave audio.

wavelength—A measurement for the distance between corresponding peaks or troughs on a transmitted wave signal.

wavetable—A group of sampled sound waves used in musical instrument digital interface (MIDI) devices. See **musical instrument digital interface (MIDI)**.

wavetable daughter card—A wavetable music synthesizer that produces musical instrument digital interface (MIDI) sounds by using a wavetable. Wavetable daughter cards work with the General MIDI (GM) standard as well as FM sound cards. See **wavetable**.

wavetable synthesis (WAV)—(Pronounced wave.) A Musical Instrument Digital Interface (MIDI) method for the discreet playback of digitally sampled instruments. Wavetable synthesis is a more expensive sound technology, but is often preferred by musicians and other sound enthusiasts because of the high-quality playback. Wavetable creates musical sounds by combining and reproducing stored digitized samples of real instruments. Compared to FM synthesis, which generates electronic sounds through the computer, the wavetable sounds are more realistic because they rely on actual instrument samples. Compare to FM synthesis. See **sound card**.

Web address—See **Universal Resource Locator**.

Web browser—A software that gives access to and navigation of the World Wide Web (WWW). Using a graphical interface that lets users click buttons, icons, and menu options to access commands, browsers show Web pages as graphical or text-based documents. Browsers allow users to download pages at different sites either by clicking hyperlinks (graphics or text presented in a different color than the rest of a document, which contains programming code that connects to another page) or by entering a Web page's address, called a universal resource locator (URL). Netscape Navigator and Microsoft Explorer are both popular browsers.

Web hosting—Providing space for, as well as placing, a customer's Web page or site on a commercial or frequently used Web server. Just like regular advertising, the price varies from Web host to Web host, with the more popular servers attracting more money.

Web page—A document written in Hypertext Markup Language (HTML) that can be accessed on the Internet. Web pages are found by addresses called universal resource locators (URLs). Web pages can contain information, graphics, and hyperlinks to other Web pages and files. Compare to **home page**. See **Web site**.

Web portal—See portal.

Web server—Software used to host Web sites. There's a wide variety of server software—from commercial products like Microsoft and Netscape's Web servers—to free servers, like Apache. These programs can run on a wide variety of computers, but usually run on Unix workstations. Operating systems for personal computers, however, such as Windows 98 and MacOS, now also come with their own built in Web servers that let users host Web pages from their computer. Of course, the server will only work if the computer has a full-time connection to the Internet. Web server can also refer to the computer running a web server.

Web site—A location managed by a single entity that provides information such as text, graphics, and audio files to users as well as connections (called hypertext links, hyperlinks, or links) to other Web sites on the Internet. Every Web site has a home page, the initial document seen by users, which acts as a table of contents to other available offerings at the site. See **home page**. See Web page.

What You See Is What You Get (WYSIWYG)—(Pronounced wizzy-wig.) The ability to get an exact match between what is seen on-screen and what is seen when the file is printed. It is normally used in reference to programs offering graphics capabilities.

What You See Is What You Print (WYSIWYP)—(Pronounced wizzy-whip.) The ability to achieve on a printout the same colors and resolution that are seen on-screen. The end result of WYSIWYP is achieved by using a color management system to calibrate printers and monitors.

what-if evaluation—A hypothetical calculation used in spreadsheets to create and compare several financial scenarios, such as the total cost of choosing one car loan and its corresponding interest rate and monthly payments over another loan option. Usually done by using formulas, situations are changed by editing one or more elements of a formula.

white book—A set of specifications for the video CD format—not to be confused with Digital Video Disc (DVD). White book specs call for compact discs in the video CD format to contain up to 74 minutes of Motion Pictures Experts Group (MPEG) video and audio. Compare to **Digital Video Discs (DVD)**.

white noise—A random noise such as a hiss, screech, or static similar to the noise produced by a radio frequently that isn't being used by a radio station.

white space—The characters, including spaces, tabs, and characters, that only appear as blanks in on-screen or printed text. In desktop publishing, white space is a section of a page that is unused by text, graphics, or other design elements. White space often is used as a design element to call attention to other objects on a page or to prevent objects from appearing crowded.

whiteboard—A program in which multiple network users can watch as one person works on an application. Whiteboards are the equivalent of chalk and blackboards, only no other person can participate in the actual application, other than the person working with the application.

whole number—A number not using fractions or decimals.

Wide Area Information Server (WAIS)—(Pronounced wace; rhymes with trace.) A search-and-retrieval tool that digs through several hundred databases and locates files that meet search criterion. Unlike some search tools, WAIS looks through the content of files located on these database servers instead of limiting itself to document titles.

wide-area network (WAN)—(Pronounced wan; rhymes with van.) A collection of computers connected (or networked) to each other over a geographic area. Wide-area networks usually require special arrangements with telephone companies because data is transmitted among locations (called sites) across telephone lines. Compare to **local-area network (LAN)**.

wideband network—See broadband network.

widow—A short last line of a paragraph, such as one word or the last half of a hyphenated word sometimes found in word processing and desktop publishing. Visually unappealing in any page layout or word processing document, this problem generally can be resolved by simply editing the paragraph or retracking text so more characters or words will be bumped onto the last line.

wildcard character—A symbol that replaces one or more characters in a file name, used in operating system and application file management procedures. Wildcard characters are most useful when users want to apply one command to several files or to a file for which they can't remember the full name. The two most common wildcard characters are the asterisk (—, also called "star") and the question mark (?). The asterisk replaces a group of characters while the question mark only replaces one.

WIMP—(Pronounced wimp.) An acronym for Window, Icon, Menu, Pointing Device that once was used as a derogatory term by text-based interface (such as Unix) aficionados toward graphical interface (such as Windows or Macintosh) users.

Winchester disk—An early disk drive developed by IBM Corp. that possessed two 30MB disks and offered a 30 millisecond (ms) access time. Still the core technology of today's larger-capacity hard drives, this drive was named after the .30-caliber Winchester rifle.

windoid—Mini-windows often referred to as "floating palettes" because they are always on top of other windows, such as a document or page layout window, and can be moved anywhere on-screen. Generally lacking title bars and minimize/maximize

buttons, they do have close icons. Common examples include the Control Palette in PageMaker or the Trap Information palette in Quark XPress.

window—A bordered area on-screen that contains an application or document, often used in graphical user interfaces (GUIs) such as Microsoft Windows or Apple Macintosh. Each window can be enlarged, reduced, or minimized to an icon, which temporarily removes it from view. A window provides for multitasking (meaning several programs can be run at once) and allow users to cut, copy, and paste information from one window to another. Additionally, windows can be arranged side-by-side (tiled) so that the user can see the full window for a document or application, or overlaid so that the front-most window is seen in full while only the title bars show for windows in the background (called cascading). Windows are enlarged or reduced by clicking on zoom buttons in the far upper-right corner of a display. When an application is open, there is another zoom button (similar in appearance to the aforementioned ones) that resizes a document window within a program, allowing the user to see, for example, several Microsoft Word files at once. Reduced windows can be resized further by placing the mouse pointer on their borders, pressing the left mouse button, and dragging to the desired position.

windowing environment—See graphical user interface (GUI).

Windows—An operating environment created by Microsoft Corp. that runs on top of MS-DOS and processes 16 bits of data at a time. Windows is often used as shorthand for Microsoft Windows 3.0 and 3.1. Although MS-DOS still controls major operations of the computer, Windows provides a consistent interface and lets users set up hardware for all programs on a system (unlike MS-DOS, which requires applications to have their own configurations). Called a graphical user interface (GUI), Windows eliminates the need to type commands at a prompt (as is the case in MS-DOS). Instead, a user can execute commands by using a mouse to select choices from drop-down menus, dialog boxes, and icons. Windows also provides multitasking for Windows- and DOS-compatible programs. Windows also is a sound card standard. See **sound card**.

Windows 3.x—Generally describes versions of Microsoft's Windows operating environment beginning with 3.0 up to 3.11.

Windows 95—A 32-bit operating system released by Microsoft Corp. in August 1995 Windows 95, just as its predecessor Windows NT, does not need MS-DOS to run. More similar in appearance to the Macintosh than to previous versions of Microsoft Windows, this operating system provides a graphical user interface (GUI) that lets users execute commands by mouse-clicking options in menus, dialog boxes, and icons. Departing from the Program Manager of Windows 3.1, Windows 95's launch pad is the Start button; users also can create shortcut icons to frequently used programs. These shortcuts can be grouped according to application or project; this means users working on a project requiring Microsoft Excel, Microsoft Word, and Microsoft PowerPoint, for example, can have a shortcut group with icons for all these packages or for the documents created in them. Windows 95 also provides the Plug-and-Play standard for PCs, which is intended to remove the onus of hardware configuration from users, only requiring them to plug in the hardware, insert the device driver diskette, and wait while Windows 95 does the configurations.

Windows DOS session—A "window frame" in which non-Windows-compatible DOS programs can be run instead of having to exit Windows. A DOS session can be run full-screen or resized to fill just part of a screen.

Windows cache size—The minimum size of the disk cache SmartDrive uses when Windows is running. It's an important setting because Windows may try to lower the size of the disk cache to free memory for itself if a minimum size hasn't been set by SmartDrive. See **cache**. See **initial cache size**.

Windows for Workgroups—A later version of Microsoft Windows 3.1 that was created to run on local-area networks (LANs). Using Windows for Workgroups eliminates the need to use a separate networking package, such as Novell Netware. Using the same graphical interface as Windows 3.1, Windows for Workgroups provides many of the same built-in applications and uses the same commands while adding such groups as Network, which provides applets such as Chat or Fax. Like its predecessor, Windows for Workgroups can process 16 bits of data at a time.

Windows Metafile Format (WMF)—A type of encoding method that allows users to share graphics between the Windows operating system and Windows-compatible programs. This method uses Windows commands to store vector graphics, bit maps, and text.

Windows NT—With an interface similar to Windows 3.1 and Windows for Workgroups 3.11, Windows NT is a bona fide operating system (rather than an operating environment) that does not require MS-DOS in order to run, thus freeing it from the limitations imposed by DOS on such elements as memory. Faster than its predecessors, Windows NT can move data 32 bits at a time, providing for better multitasking and networking. The operating system also handles up to 4GB of virtual memory (storage on a hard drive that acts as RAM), and can be run on most popular microprocessors.

Windows terminal—A type of dumb terminal that runs Windows programs on a central server. Windows terminals accept keyboard and mouse input for the server and display programs running on the server. Windows terminals can range from complete computers (those that have hard drives as well as diskette and CD-ROM drives) to slimmed-down computers that only have a monitor, keyboard, and mouse. A NetPC differs since it runs programs locally instead of merely displaying the work being done on an Windows NT server. See **dumb terminal**. See **NetPC**. See **network computer (NC)**.

Windows-based accelerator—A Super Video Graphics Array (SVGA) adapter specially created to run Windows programs faster and which should not be confused with standard SVGA cards. Although Windows is ordinarily responsible for some

video functions, the read-only memory built into this adapter stores routines that alleviate some of this burden.

WinFrame—Citrix Systems' technology that lets Windows NT function as a multi-user operating system. This allows computers that don't or can't run Windows applications, such as DOS, Macintosh, or Unix computers, to run Windows applications on a remote Windows NT server. The workstations function as dumb terminals, merely passing along keyboard and mouse input and displaying the results from the Windows NT server. This technology works well for companies with remote offices or in situations where employees perform data entry or other simple tasks. Setting up WinFrame primarily requires changes to the NT server, not to individual workstations. See **dumb terminal**. See **Windows terminal**.

WinNuke—See **blue bomb**.

WIntel—A computer with a Microsoft Windows operating system and an Intel CPU.

wizard—A feature that provides step-by-step instructions to lead users through certain tasks in applications. Unlike online help menus, which often must be read before executing a task or printed out, wizards use dialog boxes that walk users through each step of a process. Also can describe an extraordinary programmer.

WMF—See **Windows Metafile Format** (WMF).

word—A standard data unit in a computer. This is the largest amount of data a microprocessor can handle at one time and represents the width of a PC's main data bus. Expressed in quantities of 8-bit, 16-bit, and 32-bit, this measurement varies among computers. A 32-bit microprocessor, for example, would have a word length that is 32 bits (4 bytes). Also can mean a group of characters set apart by spaces or punctuation.

word count—The total number of words in a document. Word processors can perform word counts through toolbar buttons or menus. For example, Microsoft Word's Word Count feature is found on the Tools menu; WordPerfect for Windows 6.1's is under Document Information in the File menu.

word processing—The ability to create, store, and print documents using a special computer program called a word processor. Unlike typing on a typewriter, which requires retyping entire documents to make changes, word processing lets users edit documents, move and copy text, insert graphics, perform some desktop publishing functions, and delete text in a far easier and more efficient fashion than possible with typewriters. Users also can use a variety of fonts for text (even within the same sentence), perform spelling and grammar checks, format entire documents or individual pages within a document, set automatic page numbering, create templates, and set options for footnotes or automatic table of content compilation. See **word processor**.

word processor—Software that allows users to create, store, and print documents. Word processor programs offer an advantage over typewriters because users can edit documents without having to retype them. Also refers to a piece of hardware, which cannot be called a computer, but which possesses a monitor and diskette drive. Low-end models of this hardware device may only possess a liquid-crystal display screen and a dictionary. High-end models might have a high-density (HD) diskette drive, separate monitor, and spreadsheet and graph capabilities. See **word processing**.

word wrap—The automatic placement of words on a new line when they reach the right margin of a document and are too large to fit on the current line but, if moved to the next line in their entirety, would leave a blank space on the previous line. If an automatic hyphenation feature is turned on, a portion of a word may be placed on one line, split with a hyphen, and continued on the next line.

wordstuffing—The practice of placing a word or keywords in a World Wide Web site numerous times (even in obscure ways such as white text on a white background), to ensure the search engine will bring up the site as one of the top keyword matches. See **spamdexing**.

work diskette—The diskette that holds data files from which users work.

workaround—A temporary method of bypassing bugs or inoperable features of software. Workarounds, not to be confused with a "fix" (which resolves a programming problem in a program), can themselves often be ineffective, time consuming, or otherwise problematic.

workbook—A term used by the Microsoft Excel to describe a spreadsheet file. A workbook can contain numerous spreadsheets in a single file.

workgroup—A group of computers connected with networking hardware and software so users working toward a common goal can share resources, such as an accounting department or marketing division information. Workgroups can be connected to other workgroups in a larger network structure or can stand alone as separate, mini-networks.

workgroup productivity packages—Software that lets users on a network communicate and provides features such as schedulers and E-mail.

working directory—See **current directory**.

Workplace Shell—The main screen of OS/2 2.0. It provides the same function to IBM's operating system that Program Manager gives Microsoft Windows 3.1 and that the Start button gives Windows 95.

worksheet—See **spreadsheet**.

workstation—A setup composed of a computer and peripheral devices that enable someone to do their work. In terms of processing power, workstations fall between personal computers and minicomputers. Also can designate any computer connected to a network.

World Wide Web (WWW)—A graphical interface for the Internet that is composed of Internet servers that provide access to documents which in turn provide hyperlinks to other documents, multimedia files, and sites. These links are graphics or different-colored text that contain programming code which

provides the actual connection to another site. Also called Web for short. See Web browser. See Web page. See Web site.

worm—A destructive program containing code that replicates itself until it fills the target drive or network, thereby causing it to malfunction. Worms are sent out either as a practical joke or for purely malicious reasons; for the recipient whose computer or network has crashed, however, worms are not fun. See virus.

WORM—See write-once, read-many (WORM).

wrap—See text wrap. See word wrap.

wrist rest—An ergonomic device created to help PC users avoid wrist injuries, such as carpal tunnel syndrome. This pad is placed along the bottom edge of a keyboard and often is the same length as a standard keyboard. It helps prevent users from bending their wrists by keeping them flat and straight. Some wrist rests may be simple rectangular devices that lie separate from a keyboard while others may have a bracket structure into which the keyboard is placed, thus preventing the wrist rest from moving and causing injury.

write—The transfer of data from a computer's memory to a storage or output device. The write process includes such functions as saving data to a diskette and outputting a copy to a printer.

write cache—See write-back cache.

write error—An error that occurs during the transfer of data.

write mode—Allows users to edit and then save files.

write protect—A means of preventing users from editing files or saving files to a storage medium. Information can be write protected in at least three ways. Through an operating system's file management features, users can activate a read-only attribute on files by using a command such as MS-DOS' ATTRIB. On networks, sharing software can establish security settings that provide write access to some users, but not others. Lastly, diskettes have fairly unsophisticated write-protect mechanisms. On a 5.25-inch diskette a square notch is carved out of the side of the diskette (probably next to the label); covering the notch with tape restricts users to read-only access. A 3.5-inch diskette has a square hole in the upper corner of the diskette (again, probably near the label). A tab slides over the hole to lock the diskette, sliding it away from the hole restores write access.

write-back cache—A portion of memory that temporarily holds data until it can be permanently saved, usually when there is a decrease in a system's activity. This delay improves system performance over that which exists when there are frequent disk writes, because the computer is not constantly pulling data from or storing data to disk. Also called write-behind cache or write cache.

write-behind cache—See write-back cache.

write-once, read-many (WORM)—(Pronounced worm.) A CD-like device that allows data to be recorded on it and then read over and over. Popular for data archiving because of its large storage capacity, WORM discs have yet to be given a standard format, thereby requiring users to use the same format. Should not be confused with CD-ROM, which does not allow data to be written to the disc.

WWW—See World Wide Web.

WYSIWYG—See What You See Is What You Get (WYSIWYG).

WYSIWYP—See What You See Is What You Print (WYSIWYP).

x-axis—The horizontal reference line found on a plane. A plane (which can be a grid, chart, or graph) is designed to measure the placement of a point in relation to the x-axis, y-axis (vertical plane), and z-axis (third-dimension plane). In computer technology, these planes are helpful when

write protect
(notch in diskette corner)

tracking the mouse or cursor position on a grid, such as on a computer's monitor, a template of a desktop publishing document, or a digitized tablet. Compare to y-axis. Compare to z-axis.

x-height—The height of the lowercase letter x. The x-height represents only the height of the body of a lowercase letter; it doesn't include descenders (such as the "tail" on the letter y), or ascenders (such as the upper "stem" on the letter h). Two fonts can be the same point size, yet appear to be different sizes because they have different x-heights. In desktop publishing, this can be one factor to consider when choosing a font.

X-Windows—A windowing and graphics system developed at the Massachusetts Institute of Technology for Unix workstations. In the X-Windows system, graphical user interfaces are created independent of computer hardware. Examples include Motif and OpenLook. See Unix.

X.25—A CCITT X series standard for packet-switching protocol on local-area networks (LANs). Its standards are related to layers 1, 2, and 3 in the OSI Reference Model. The X.25 standard is used by all types of computers from mainframes to minicomputers. The CCITT, now absorbed into the main body of the International Telecommunication Union (ITU) approved the X.25 standard in 1976. See CCITT X series.

X.400—A CCITT X series standard and the universal E-mail protocol, which translates E-mail messages, allowing them to be transmitted between different systems regardless of which program was used to create and/or send the E-mail message. A drawback in the X.400 standard is that the sender's name is not included with the message. See CCITT X series.

X.500—A CCITT X series standard that builds upon the standardization of the X.400, extending the protocol to include address formats. See **CCITT X series**.

xDSL—A reference to all types of Digital Subscriber Line (DSL), including Asymmetric DSL (ADSL), High Speed DSL (HDSL), Rate-Adaptive DSL (RADSL), Single-Line DSL (SDSL), and Very High Bit Rate DSL (VDSL). Digital Subscriber Lines provide high-speed data transfers over existing telephone lines. See **Asymmetric Digital Subscriber Line (ADSL)**. See **Digital Subscriber Line (DSL)**.

Xenix—Microsoft Corp.'s version of the Unix operating system that runs on PCs. See **Unix**.

Xerox network services—A now-obsolete communications protocol used in early Ethernet networks that has been replaced with Transmission Control Protocol/Internet Protocol (TCP/IP).

Xerox Palo Alto Research Center—The site of vital computer-related research center in California beginning in the 1970s and continuing today.

Xerox PARC—See **Xerox Palo Alto Research Center**.

XFCN—See **external function (XFCN)**.

XGA—See **Extended Graphics Array (XGA)**.

Xmodem—A popular file-transfer protocol developed in 1977 by Ward Christiansen. The protocol works by sending blocks of data in 128-byte blocks from PC to PC. Included with this data is an error-detection system called a checksum. When the data is received, the error detection system ensures that the entire message reached its destination. If not, the receiving computer sends a request for retransmission of the data. Compare to **Ymodem**. Compare to **Zmodem**.

Xmodem 1k—A more powerful version of Xmodem that allows large files to be sent greater distances with the same reliable error-checking. Information is transmitted in 1KB blocks as opposed to Xmodem, which transmits information in 128-byte blocks.

Xmodem-CRC—The Xmodem protocol with an additional cyclical redundancy check (CRC). See **cyclic redundancy check (CRC)**.

XMS—See **Extended Memory Specification (XMS)**.

XMT—See **transmit (XMT)**.

XON/XOFF—XON and XOFF are control characters used in data transmission. XOFF is used by a receiving PC to tell the transmitting PC to stop transmitting. When it is all right for the transmission to recommence, the XON character is sent. See **handshake**.

XOR operator—A Boolean operation, often used in database searches, that returns a value of true only if its operands have different values (one is true and one is false). Also called the exclusive OR. See **Boolean**.

Y-splitter—A single cable that meanders into two sections and thus forms a Y shape, allowing you to hook up two devices, such as two joysticks, to be used simultaneously.

XT—See **crosstalk**. See **extended technology (XT)**.

Y/C video—See **super-video (S-video)**.

yellow book—The specifications for the CD-ROM and CD-ROM extended architecture (CD-ROM XA) formats. See **CD-ROM**. See **CD-ROM extended architecture (CD-ROM XA)**.

Y

y-axis—A reference line representing the vertical column in a plane. A plane (which can be a grid, chart, or graph) is designed to measure the placement of a point in relation to the x-axis (horizontal plane), y-axis, and z-axis (third dimension plane). In computer technology, these planes are helpful when tracking the mouse or cursor position on a grid such as on a computer's monitor, a template of a desktop publishing document, or a digitized tablet. Compare to **x-axis**. Compare to **z-axis**.

Ymodem—A file-transfer protocol similar to the enhanced 1K version of Xmodem. Ymodem also allows multiple file transmission, performs cyclical redundancy checks (CRC), and can reduce the transfer size to compensate for a poor connection. Compare to **Xmodem**. See **cyclic redundancy check (CRC)**.

yoke—An input device used with computer games, typically with flight simulation games, that allows the user to fly up or

down, back or forward by pulling or pushing the steering wheel-like device.

Z

z-axis—A reference line representing the third dimension in a three-dimensional (3-D) plane. A plane (which can be a grid, chart, or graph) is designed to measure the placement of a point in relation to the x-axis (horizontal plane), y-axis (vertical plane), and z-axis. In computer technology, these planes are helpful when tracking the mouse or cursor position on a grid such as on a computer's monitor, a template of a desktop publishing document, or a digitized tablet. See **y-axis**. See **x-axis**.

Z-buffer—An area that stores the Z-axis pixels of any two-dimensional (2-D) feature plotted on the coordinates X, Y. The Z-buffer is intended to hide the lines in a 2-D rendering of a three-dimensional (3-D) object. See **three-dimensional (3-D)**. See **two-dimensional (2-D)**.

zap—The complete elimination of data on a storage medium, leaving the medium available for future storage.

Zapf Dingbats—A font comprised of printers' symbols from the International Typeface Corp. that includes arrows, geometric shapes, stars, and circled numbers. It is a built-in font in PostScript laser printers and can be purchased in Type 1 or TrueType format for other printer types. The font's formal name is ITC Zapf Dingbats.

ZAW—See **Zero Administration for Windows (ZAW)**.

Zero Administration for Windows (ZAW)—A feature created for Windows NT, which allows users to manage and oversee the functions of certain applications located on a local-area network (LAN). ZAW also facilitates efficiency for installing software and upgrading. See **local-area network (LAN)**.

zero divide—To divide a number by zero, which is impossible. Such a calculation produces a result that can't be calculated. In computing, therefore, division by zero can't take place in any program. If it does, it causes operational problems.

Zero Insertion Force (ZIF) socket—A device that makes the insertion or removal of an Intel Corp. microprocessor to or from the motherboard easier. The built-in handle eliminates the need for any special tools and reduces the number of broken chips.

zero out—To set a variable or series of bits at zero.

zero page—The first 256 bytes of memory in computer systems based on the 6502 microprocessor.

zero suppression—To remove zeros from a number without affecting its value. The number 000.444, for example, could be written as .444.

zero wait state—Description applied to RAM memory that runs at its maximum speed when processing responses from the microprocessor without requiring any wait states. See **wait state**.

ZIF socket—See **Zero Insertion Force (ZIF) socket**.

zip—To compress a file. Compare to **unzip**.

ZIP—A widely used disk compression format associated with PKWARE Inc.'s PKZIP (for compressing files) and PKUNZIP (for decompressing files). The words "zip" and "zipped" are slang for a compressed file; "unzip" and "unzipped" refer to decompressed files. After a file is compressed, it is usually given the .ZIP file extension. Compare to **self-extracting file**. Compare to **UNZIP**.

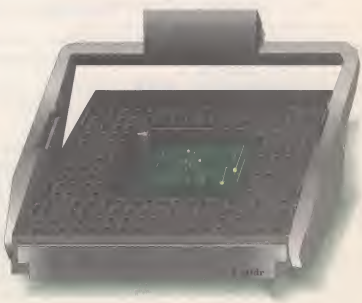
Zmodem—A file-transfer protocol that uses cyclical redundancy check (CRC) to detect errors and is designed to transfer large files. Its predecessors were Xmodem and Ymodem. Compare to **Xmodem**. Compare to **Ymodem**.

zone—Located inside a local-area network (LAN), zones are subsets of the larger network.

zone header—See **header**.

zoom—To make a window larger when using graphical interfaces. In many applications, a zoom box lets the user maximize a window, making it fill the entire screen. When the zoom box is selected again, the window returns to its original size. Also refers to magnifying a portion of a document on-screen in order to view it more closely.

zoom box—See **zoom**.



Zero Insertion Force socket

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